Public Affairs Office
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January 5, 1970

IMMEDIATE RELEASE

Release No. 70-3

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has shipped a test version of the Saturn V vehicle's third stage to the McDonnell Douglas plant at Huntington Beach, Calif., for modification.

The stage, formerly identified as the S-IVB 500 F or facilities stage, will be converted into a Saturn V Workshop "dynamics test article." Once the modification is complete, the stage will be used in the Apollo Applications Program's dynamics and acoustics testing activity.

The stage was formerly a part of the Saturn V facilities vehicle used to check out manufacturing, testing and launching facilities early in the Apollo/Saturn V program. The Marshall Center received the stage back from the Kennedy Space Center about a year ago.

The Saturn V Workshop is one of the Apollo Applications Program projects being developed by the Marshall Center for launch in 1972. Current plans call for visits by three astronauts for stays of up to 56 days duration.

The S-IVB stage was shipped from the Marshall Center to the West Coast aboard the Super Guppy aircraft on January 2.

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HOLD FOR RELEASE:

January 11, 1970

Release No. 70-5

MARSHALL SPACE FLIGHT CENTER, Ala. -- Scientists here are advancing the laser as a means of detecting and measuring that invisible menace of aviation, clear air turbulence.

Because clear air turbulence (CAT), really a storm of clear air, cannot be seen or detected by conventional radar it is feared in the aviation world. Unpredictable and often devastating things occur when a plane moves through these storms.

Research at the NASA-Marshall Space Flight Center shows that an airborne laser system for detecting clear air turbulence is possible.

Robert M. Huffaker, a physicist in the Aero-Astrodynamics Lab, has been working on an optical doppler system which he says has proved itself in feasibility studies. He hopes to have an airborne version of the laser system in operation in about a year.

A carbon dioxide gas (CO_2) laser is being used as the power source for the Marshall Center system. Such an optical system measures atmospheric wind velocity directly and is thus a direct measurement of turbulence, Huffaker said.

He said the laser system operates on much the same principle as a conventional doppler radar, except a coherent laser pulse is used instead of

radio frequency energy. Motion of small particles in a turbulent air mass causes the laser pulse frequency to shift. The difference in the transmitted and received scattered frequency is compared in a receiver and the system's operator has a direct measurement of the air mass' velocity. The spread in velocity will indicate the intensity of the turbulence. He says the system is similar to regular doppler radar on aircraft, except when the laser is used there is about 10,000 times better resolution.

Huffaker said a laser doppler system was developed in wind tunnel tests at the Marshall Center. Jet flows were measured by the doppler system in wind tunnel tests and results were then compared with more conventional measuring methods. On the basis of the wind tunnel tests, he said, "we looked into other applications, such as an airborne detection of CAT. We have compared doppler data in actual measurements in excess of Mach 2," he points out.

The research phase of the CAT detection system is near completion. The hardware development is presently being performed by Raytheon Co. Lockheed-Huntsville and Wayne State University are working on "hardware, systems design studies, and theoretical design parameters." The Air Force's Cambridge Research Laboratory is cooperating with MSFC on the research problem.

The final design of the airborne unit should be completed next month. Huffaker pointed out that the contract effort for completing the building and testing of the hardware is in process.

He said a small aircraft, probably a jet, will be selected within the next few months to test the airborne doppler system.

Although the CAT detection system is aimed at regular airline use, Huffaker said, the purpose of the first research system is to demonstrate feasibility. It is expected that the system will also be used for research purposes in the study of the structure and characteristics of atmospheric turbulence. Early flight tests will be performed to determine the system's range capability. The range of the research unit is expected to be in excess of 10 kilometers.

Huffaker explains that the CO_2 laser technology is changing rapidly and the estimate of the system's capability is "conservative." He forecasts many more advances in the "state-of-the-art" while the airborne system is under development.

Huffaker said most other laser detection systems were dismissed because they "just would not work." Other approaches have been passive systems which attempted to infer turbulence from an indirect measurement such as temperature or intensity of back scattered light.

Other laser techniques were dismissed because they were a passive (indirect) measuring system and were considered a possible safety hazard because of the visible radiation.

The present laser system uses a CO_2 laser which is out of the visible light spectrum at 10.6 microns. This radiation does not penetrate glass and the power levels used will not present a safety problem.

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January 13, 1970

IMMEDIATE RELEASE

Release No. 70-7

MARSHALL SPACE FLIGHT CENTER, Ala. -- Saturn V hardware activity this week is highlighted by the planned static firing of an S-IC booster stage at the Mississippi Test Facility. Scheduled to become part of the SA-513 launch vehicle, the booster will be fired later this week, tentatively tomorrow, Jan. 14.

Another S-IC stage--scheduled for the SA-509 vehicle--arrived at the Kennedy Space Center Sunday, Jan. 11, from M.F. It was unloaded Monday morning at KSC.

The second (S-II) stage for SA-509 left MTF today, scheduled to arrive at KSC next Tuesday, Jan. 20. Also today, the S-IVB for SA-509 was loaded for shipment from the West Coast by air; it will arrive at KSC Thursday, Jan. 15.

SA-509 will boost the Apollo 14 flight, scheduled for a lunar exploration mission in September or October.

In addition to the S-IC firing at MTF, crews are to remove S-II-11 from its test stand tomorrow. S-II-10 is scheduled to go onto a stand Thursday, Jan. 15.

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January 20, 1970

IMMEDIATE RELEASE

Release No. 70-10

MARSHALL SPACE FLIGHT CENTER, Ala. -- A veteran rocket program manager, Robert E. Lindstrom, has rejoined the NASA-Marshall Space Flight Center as deputy director of the Manufacturing Engineering Laboratory, Science and Engineering directorate.

Lindstrom, 41, first became associated with the rocket development group here in 1951. In the late 1950's and early 1960's, he managed, successively, the Juno I, Juno II and Saturn I projects.

He resigned in 1963 and has since then been associated with local aerospace companies.

Lindstrom's new appointment is subject to formal approval by NASA Headquarters.

Mr. and Mrs. Lindstrom and their three children live at 5732 Jones Valley Dr., Huntsville.

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January 22, 1970

IMMEDIATE RELEASE

Release No. 70-12

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has selected Chrysler Corp., General Electric Co. and the Boeing Co., all of Huntsville, for competive negotiations leading to a contract to provide management, sustaining engineering, and logistics support for the Saturn launch vehicle ground support equipment, and for operations and maintenance of the Saturn systems development facilities here.

This contract will cover work previously provided by six contracts relating to Saturn IB and Saturn V ground equipment.

The value of the contract over the next three years is estimated in excess of $25 million.

The cost-plus-incentive-award-fee contract will be administered by the Marshall Space Flight Center under the direction of NASA's Office of Manned Space Flight in Washington.

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January 26, 1970

IMMEDIATE RELEASE

Release No. 70-14

MARSHALL SPACE FLIGHT CENTER, Ala. -- The Marshall Space Flight Center has modified its contract with the Boeing Company to include changes incorporated in the first stage of the Saturn V rocket.

The changes were made on subsequent flight stages after the second Saturn V experienced excessive oscillations on an unmanned research and development flight April 4, 1968.

Under the $4,360,260 modification, Boeing installed "accumulators" or small gas reservoirs in the liquid oxygen prevalves of the first stage to change the frequency of oscillation in the propulsion system. Additional ground testing and studies of flight data led to the decision to install the accumulators.

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January 28, 1970

IMMEDIATE RELEASE

Release No. 70-22

MARSHALL SPACE FLIGHT CENTER, Ala. -- Dr. Wernher von Braun, whose appointment as NASA Deputy Associate Administrator for planning was announced yesterday, today issued the following statement:

"Leaving my Marshall home and team-mates of many years was no easy matter to contemplate. Only two factors made it possible at all.

"First, the challenge which the new position offers. We indeed have man on another heavenly body and have in fact developed a spacefaring capability that few dreamed would come to pass. Now, is the time to consolidate and utilize the gains that our past successes in the space program have won us. To help Dr. Paine, Dr. Low, and Dr. Newell and other NASA leaders develop a space program worthy of the seventies and eighties is an immense opportunity. I am very, very grateful, and I approach my new job with tremendous enthusiasm.

"Second, while it would be most difficult to deliberately terminate relationships that go back, in some cases, nearly four decades, I am not really being called on to do that. I will continue to work very closely with my colleagues here, and I'll be back in Huntsville time and time and time again--in fact, every time I'm given a chance. I will need the daily help of Marshall experts, and of others throughout NASA, to do the planning job I am charged with.

"I know I leave the Marshall Center in good hands. There's not a better man anywhere to take over here. I wish Dr. Rees and all other Marshall employees well."

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January 29, 1970

IMMEDIATE RELEASE

Release No. 70-23

MARSHALL SPACE FLIGHT CENTER, Ala. -- The world's largest tuna fishing boat, to be christened in a few weeks, is a better ship due to space-age technology.

The ship, launched January 24 at San Diego, Calif., is undergoing a series of tests and sea trials. Final outfitting, installation of systems and remaining repainting will be completed before the formal christening ceremonies.

The ship features insulation by polyurethane--a tough, lightweight plastic foam used in insulating rockets that propel astronauts and their spacecraft to the moon.

Polyurethane is not new--but its widespread use and the realization of its potential did not enter the picture until aerospace engineers and scientists began developing ways to apply it to rockets.

The second stage of the Saturn V launch vehicle contains 7.400 square feet of the material. It insulates the fuel tank and helps keep the liquid hydrogen--at minus 423 degrees Fahrenheit--from getting warmer and turning to a useless gas.

The $2 million tuna clipper is 200 feet long and has a 42-foot beam. It will haul up to 1,300 tons of fresh tuna in its fish wells below decks.

The fish wells are insulated with the polyurethane foam and cooled to near zero degrees Fahrenheit by brine circulated through a refrigerant system. The insulation was applied by North American Rockwell Corp., prime contractor to the NASA-Marshall Space Flight Center for the Saturn V second stage.

The spray foam is about one-fifth as heavy as cork and is a closed-cell material. The lighter material gives the ship more cargo capacity. Also, being closed-cell, it is expected to last the lifetime of the ship. The cork it replaces as insulation has a lifetime of about three years.

Some formulas for the spray foam permits the material to enure and dry within fifteen seconds of spraying. The type used on the ship takes a little longer, giving the application technicians time to fill all the cavities before it hardens.

The polyurethane material is excellent for insulation, both for noise and temperature. It has been used recently to insulate walk-in coolers and garage doors.

It is still too expensive for home insulation--about 30 to 35 cents per square foot--but holds promise for the future. It is used in door jambs in hospitals to deaden the sound of closing doors. Its use in refrigerator vans also is growing.

Air-supported buildings--balloon-like structures that stay up only while air is being pumped into them--can now be sprayed on the inside with polyurethane. Once the material hardens, the air can be turned off and the building will remain standing.

Panels one inch thick are being used for quick-erection buildings in the arctic. A framework is bolted together and the panels are put in place with pins to form buildings that keep the heat in and the cold out almost as efficiently as a thermos bottle.

Polyurethane has been used for making lightweight boats for some years. With the increase in applications technology, brought about by the space program, more and more uses for the material are being found daily.

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February 2, 1970

IMMEDIATE RELEASE

Release No. 70-25

MARSHALL SPACE FLIGHT CENTER, Ala. -- A small lunar rock brought by the Apollo 11 astronauts from the lunar surface to earth last July will be displayed at the NASA-Marshall Space Flight Center and at other points in the Southeast during the next 60 days.

The small rock is located in a sealed transparent cylinder and will be under guard at each location.

It will be displayed in the Marshall Center's headquarters building Feb. 2-3, and in several other Marshall Center buildings through Feb. 6.

The public may also view the rock at the Madison County Courthouse in Huntsville Feb. 9-13; and at the Huntsville City Hall Feb. 14-15.

In addition, it will be shown at Fayetteville, Tenn., Feb. 16-17; at the Mississippi Test Facility Feb. 19-22; Michoud Assembly Facility Feb. 23-27; at the Alabama Space And Rocket Center in Huntsville Feb. 28 and again March 17-23; in Decatur March 2-4; Ardmore, Tenn., March 6; Triana, March 8; Birmingham March 10-15; at the Army Missile Command in Huntsville March 25-27 and again at the Marshall Center March 28-31.

The rock is part of an exhibit which gives further details about the initial lunar landing. Since that mission, another crew made a second landing in another location.

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For Immediate Release

Release No. 70-35

September 30, 1970

BAY ST. LOUIS, Miss.--The last in a series of fifteen Saturn V flight boosters (S-IC-15) was captive fired for more than two minutes late today at the NASA-Mississippi Test Facility.

Ignition of the stage's five powerful engines took place at 6:17:05 p.m. and cutoff came at 6:19:20 p.m.

Early evaluation of test results show that the test was successful.

The test, originally scheduled to take place at 4 p.m., was delayed for more than two hours by an electrical malfunction in a liquid oxygen barge used to carry the propellant to the test stand.

The Boeing Company built the stage for the space agency at the Michoud Assembly Facility in New Orleans. Boeing personnel conducted today's test.

The S-IC-15 will be barged back to Michoud for post firing checks and storage.

Captive testing of the Saturn V first stages began at MTF on May 16, 1967. Since that time a total of 12 S-IC stages have been acceptance fired in MTF's role to test, checkout and flight certify stages and engines for manned lunar launches.

Saturn V second stages are also tested at MTF. The final test in that series is scheduled for late next month.

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March 19, 1970

IMMEDIATE RELEASE

Release No. 70-49

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration sees the 1970's as a decade of unmanned planetary exploration, Earth orbiting space stations, lunar roving vehicles, and even a shuttle service ferrying men and supplies on trips to and from Earth orbit.

But at least one group at the NASA-Marshall Space Flight Center is studying the manpower relationship to the hardware--the motivational aspects of aerospace workers.

During a Manned Flight Awareness Workshop held this week at the Marshall Center, 51 representatives of nearly 20 industrial firms and several government agencies met to plan various programs to promote space flight safety and hardware reliability among the work forces of this new decade.

They discussed such topics as sustaining motivation during critical periods, employee recognition and communications, participation by various hardware suppliers and subcontractors and making use of time between peak work periods.

Following the Workshop, the group will make recommendations relating to human performances in the 1970's.

The Workshop was conducted under the direction of the NASA Office of Manned Space Flight and its Safety Director, Jerome Lederer. The Marshall Center program was conducted by Dr. Preston T. Farish, manager of System Safety and Manned Flight Awareness.

Firms represented include: AC Electronics of Kennedy Space Center, Fla.; the Boeing Company's operations in Huntsville, Cocoa Beach, Fla., and New Orleans; Chrysler Corp. operations in New Orleans and at Cape Canaveral; The Defense Contracts Administration Services of Alexandria and Cameron Station, Va.; Elliott Judson Roberts Co., of Mt. Vernon, N. Y.; Grumman Aerospace operations at Bethpage, N. Y., and Kennedy Space Center, Fla.; IBM Corp. operations at Huntsville, Cape Canaveral, Fla., and Gaithersburg, Md.; the Martin Marietta Corp. in Denver and Huntsville; McDonnell Douglas Astronautics in Huntington Beach, Calif. and Cocoa Beach, Fla.

NASA elements from the Michoud Assembly Facility, New Orleans; Kennedy Space Center, Fla.; Marshall Center; Manned Spacecraft Center, Houston; North American Rockwell Corp. operations at Canoga Park and Downey, Calif., and Cocoa Beach, Fla.; RCA Operations in Camden, N. J. and at Huntsville.

Service Technology of Slidell, La.; Thiokol Chemical Corp., Huntsville; Trans World Airlines of Kennedy Space Center, Fla.; TRW Systems Group of Redondo Beach, Calif.; and the Army Missile Command at Redstone Arsenal, Ala.

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April 1, 1970

IMMEDIATE RELEASE

Release No. 70-58

MARSHALL SPACE FLIGHT CENTER, Ala. -- A proposed High Energy Astronomy Observatory (HEAO) project was explained to scientists interested in developing experiments at a one-day pre-proposal briefing today at the NASA-Marshall Space Flight Center.

Approximately 155 representatives from industry, educational institutions and government attended the briefing.

HEAO is a proposed earth orbiting satellite carrying experiments for stellar astronomy. The automated spacecraft, expected to be about 30 feet long and 9 feet in diameter, is presently being planned for a 1974 launch.

Scientists attending the briefing were given information on the part HEAO will play in physics and astronomy plans, scientific planning for HEAO, description of the HEAO program and design concept, and scientific experiment selection.

Scientists wishing to participate in the HEAO program will submit experiment abstracts on May 1 and final proposals are expected by June 1.

Marshall Center's HEAO program officials expect to receive from 50 to 60 experiment proposals.

HEAO experiments will be designed to evaluate the stars by measuring their X-ray and Gamma Ray emission.

The HEAO program is being directed by the NASA Headquarters Office of Space Science and Applications. The Marshall Center is directing the study of the satellite. There are presently four satellites planned for the HEAO series.

Speakers at the pre-proposal briefing included: David H. Newby, director of Administration and Technical Services; Alois W. Schardt, deputy director, Physics and Astronomy Programs, OSSA; Dr. Frank McDonald, HEAO Study Project Scientist, Goddard Space Flight Center; Carroll Dailey, MSFC HEAO Phase A Study Team; Dr. Albert G. Opp, program scientist, HEAO Physics and Astronomy Programs, OSSA, and Richard E. Halpern, HEAO Program Manager, Physics and Astronomy Programs, OSSA.

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April 22, 1970

IMMEDIATE RELEASE

Release No. 70-74

MARSHALL SPACE FLIGHT CENTER, Ala. -- The Apollo 13 mission's Saturn V launch vehicle (AS-508) successfully injected the Apollo spacecraft into the correct trans-lunar trajectory, aiming for a lunar landing.

A study of data from the launch vehicle shows that excessive vibration on the second (S-II) stage's center engine caused an early shutdown of that engine. That was the only deficiency noted in the rocket's flight.

The second stage's four outer engines burned about 34 seconds longer than scheduled, and the third (S-IVB) stage single engine burned 12 seconds longer, to compensate for the early engine cutoff.

Several available "fixes" are being considered for a solution to the problem. Preliminary analysis of flight data indicates that an automatic early cutoff occurred due to action of "thrust OK switches" on the center engine.

Large pressure oscillations in the liquid oxygen system, coupled with vibrations in the center engine support structure, started a chain of

events that led to center engine cutoff 132 seconds earlier than planned. No apparent engine or structural damage occurred.

Oscillations during second stage burn were expected on the launch vehicle, Saturn V rocket AS-508, because similar oscillations had occurred on previous flights. On those flights, however, the oscillations rose in amplitude to an acceptable level and remained in that range. On the AS-508 vehicle the oscillations first occurred at low levels, as in the earlier flights, then increased just before engine cutoff.

The oscillations in the liquid oxygen feed system caused the pressure at one instant to drop below the minimum required, resulting in LOX pump cavitation. Cavitation, the creation of gas-filled spaces or bubbles in the liquid oxygen, reduced pump efficiency and, in turn, engine thrust.

The reduced engine thrust, as indicated by chamber pressure, in conjunction with thrust oscillations, was enough to trip the thrust OK switches that initiated cutoff.

The low frequency oscillations, 14 to 16 cycles per second, were localized. Sensors on the center engine structure picked up readings of more than 20 G's. These oscillations were not passed to the command module, however, because sensors in the CM recorded lower than 0.1G levels at that time.

Oscillations had been encountered earlier in the first stage of the AS-502 vehicle. That "Pogo" problem was solved by installing accumulators

in the liquid oxygen lines. Similar problems have been encountered in the Titan and Thor launch vehicles.

Accumulators are gas-filled cavities which are normally located in the propellant feed lines to "de-tune" the structural and propulsion system elements and suppress oscillation buildup.

Saturn V engineers are considering the accumulator as well as other methods of solving the problems but no firm decision has been made.

The early engineering evaluation of AS-508 indicated that all mandatory and desirable objectives set for the launch vehicle were met and that the three-stage rocket performed satisfactorily.

The Saturn V was developed under the direction of the NASA-Marshall Space Flight Center. The first stage was manufactured by the Boeing Co., the second stage by North American Rockwell, Inc., the third stage by McDonnell Douglas Astronautics Co., and the instrument unit by IBM.

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April 27, 1970

IMMEDIATE RELEASE

Release No. 70-77

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has issued a request for quotations to 18 aerospace firms for bids on a lunar base synthesis study.

Objectives of the study are to define and analyze lunar exploration missions that may be desirable and possible in an integrated program plan, establish respective requirements, and develop conceptual descriptions of semi-permanent lunar surface bases that will allow designated mission objectives to be achieved.

From the effort, optimum types of mission support equipment will be derived and operational limitations will be shown.

The usefulness of mobile systems for long traverses will be considered, different types of surface drills and other tools and equipment will be examined, and the capabilities of flying and surface roving vehicles will be related to the needs of different types of missions.

The mobile system to be considered for long traverses would be a mobile shelter and laboratory capable of supporting two men for two weeks on the moon's surface.

Conceptual designs of at least two different lunar surface shelters will be prepared. One concept will be derived from a specified space station module, and the other shelter will be designed to function only on the lunar surface and will be designed to meet the requirements for a variety of lunar surface missions.

The study will examine all aspects of operation of a semi-permanent lunar surface base without the existence of a lunar orbit space station, operation of such a base while a lunar orbit space base is in use, missions that could be performed from such a surface base, and surface missions that could be performed from either a lunar orbit station or a surface base.

Bids on the study are due May 5.

Firms invited to bid were: McDonnell Douglas Astronautics Co., the Boeing Co., Grumman Aircraft and Engineering Corp., General Dynamics Corp., General Electric Co., Lockheed Aircraft Co., Chrysler Corp., Martin-Marietta Corp., TRW, Inc., Bendix Corp., North American Rockwell Corp., Federal Electric Corp., IIT Research Institute, Northrop Corp., Westinghouse Corp., Brown Engineering Co., Fairchild-Hiller, and the Garrett Corp.

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April 27, 1970

IMMEDIATE RELEASE

Release No. 70-79

MARSHALL SPACE FLIGHT CENTER, Ala. -- A contract between the NASA-Marshall Space Flight Center and North American Rockwell Corp. has been modified to pay for changes made to the second stage of the Saturn V launch vehicle.

The changes include the testing and replacement of certain components that have caused corrosion problems on the S-II second stage. Seven stages, S-II-9 through S-II-15 will be modified.

Negotiated changes included in this modification will amount to $4,435,275. The work will be completed by March 31, 1973, and will be done by North American's Space Division at Seal Beach, Calif., and the Marshall Center's Mississippi Test Facility, Bay St. Louis, Miss.

North American Rockwell builds and tests all second stages of the three-stage Saturn V launch vehicle that boosts Apollo exploration missions to the moon.

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April 28, 1970

SATURN WORKSHOP

The National Aeronautics and Space Administration proposes to place an embryonic space station--the Saturn Workshop--into earth orbit in 1972 to gain a better understanding of the requirements for a permanent man-made platform in space. As a major part of NASA's Skylab Program, the Workshop will make use of hardware and techniques developed in the Apollo lunar landing program to further explore and extend man's usefulness in space. Economy will be achieved through the full use and modification of Apollo spacecraft and Saturn launch vehicles.

The Saturn Workshop will provide an environment in which man can live and work in space under controlled conditions for long periods. Experiments conducted in the Workshop will develop data on man's physiological and psychological responses to the space environment and provide more detailed information on his abilities for extended manned flight.

The development of long-duration flight is a key requirement for further advances in manned flight. Extended flight experiments are also necessary as a basis for future design decisions, including permanent

manned facilities in space (such as space stations) or manned flights to the planets (such as the proposed Mars mission).

The launch vehicle for the Workshop will be the first two stages of a Saturn V. The vehicle's third stage (the S-IVB) will become the Workshop module--fully modified and outfitted on the ground as living and working quarters for three astronauts. The stage's liquid hydrogen tank will become a 10,000-cubic-foot space laboratory, many times larger than any spacecraft yet flown. Attached to the Workshop will be a solar observatory--called the Apollo Telescope Mount--that also is a prime experiment in the Skylab Program.

Major pieces of new equipment being developed for the Skylab Program are an airlock module and a multiple docking adapter (MDA). The airlock and the MDA will allow astronauts to move from the Apollo spacecraft into the Workshop without depressurizing either unit. The docking adapter, attached to the airlock, also provides a way of joining additional payloads to the Workshop. The entire cluster--Workshop, Apollo Telescope Mount, Apollo spacecraft, airlock and multiple docking adapter--is called Skylab.

Mission Sequence

One Saturn V and three Saturn IB launch vehicles will be used to place the first Skylab payloads into earth orbit. The Workshop, ATM, airlock and MDA will be launched unmanned atop a Saturn V from Launch

Complex 39 at NASA's Kennedy Space Center, Florida, and placed in a 235-nautical-mile circular orbit.

A day or two later, a three-man crew will be launched in an Apollo spacecraft by a Saturn IB vehicle from Launch Complex 34 at the Kennedy Center. The manned Apollo spacecraft will rendezvous with the Workshop and dock with the MDA. Astronauts will enter the Workshop for a 28-day mission.

About two months later another crew of three astronauts will return to the Workshop and operate experiments for as long as 56 days. A third Skylab flight will be made about a month after the second crew returns to earth. The third crew will again stay in space for up to 56 days. At the end of each mission, the crews will prepare the Workshop for an inactive period, then return to earth in their command modules with experimental data. The operational lifetime of the Workshop will be about eight months.

The Skylab, excluding the Apollo spacecraft (which will be launched on a separate vehicle) will weigh about 130,000 pounds. Most Skylab hardware is being furnished by the Marshall Space Flight Center and its contractors. MSFC is building the ATM, with most of the scientific equipment provided by industry. Marshall is also providing the MDA structure, with Martin-Marietta Corp. providing instrumentation. McDonnell Douglas Astronautics Co. is the Workshop hardware contractor, with design work being done by McDonnell Douglas and MSFC. The Apollo

spacecraft is being provided by the NASA-Manned Spacecraft Center; North American Rockwell Corp. is the prime contractor.

The Saturn Workshop will be launched with most of its equipment in place. The airlock module will be mounted on the forward end of the stage, and the docking adapter will be rigidly mounted at the forward end of the airlock. Two solar arrays will be mounted to the stage's outer wall.

S-IVB stage tankage will be the primary flight hardware. The stage's engine and other propulsive hardware will be removed, and a reusable access hatch will replace an existing manhole cover in the forward tank dome. Aluminum grid-pattern floors and ceilings will be placed in the tank to divide it into a two-story "space cabin." An aluminum foil, fire-retardant liner will be placed around the inside tank insulation surface, and a meteoroid shield will be located on the stage's exterior.

Crew quarters, one of the most important sections in the Workshop, will be located at the aft end of the tank. The ceiling grid will separate these quarters from a large laboratory area in the tank's forward end. Solid partitions will divide the crew quarters into a sleep compartment, a wardroom, a waste management compartment and a work space. A ceiling over the quarters will contain lighting fixtures. The wardroom and the waste management compartment will be separately sealed with walls and doors to retain odors and loose particles in the weightless environment.

A window, 18 inches in diameter, will be located in the middle of the wardroom, facing the sunlight side of the earth. It will have double-pane glass, with heaters to keep it from fogging.

The crew quarters are relatively large. The wardroom has about 100 square feet of area, and the waste management compartment has 30 square feet of floor space. The sleep compartment has about 70 square feet of space, and the crew quarters work area has 180 square feet. A thermal control and ventilation system will give the astronauts a habitable environment with a temperature ranging from 60 to 90 degrees F. A two-gas (oxygen and nitrogen) atmosphere will be used, with internal pressure kept at five pounds per square inch. Fans will circulate the aritificial atmosphere to keep a constant temperature.

An electrical power distribution system will be installed to connect the Workshop areas with power sources in the airlock and the solar cell assemblies. Light fixtures can be individually controlled, and portable lights may be used for additional illumination.

The meteoroid shield will decrease the probability of hazardous punctures to the Workshop. It is an 0.025-inch aluminum sheet, held against the stage's cylindrical tank wall during launch. Once in space, it will be deployed by swinglinks (powered by torsion bars) and will be held five inches from the tank wall in orbit.

Water and food will be stored inside the Workshop for the total operational lifetime. Solar arrays on the Workshop and the ATM will give electrical power for the entire Skylab; the systems are cross-linked for flexibility in handling peak loads and for countering failure.

Skylab Experiments

About 50 experiments are being considered and developed for use in the Saturn Workshop and the Apollo Telescope Mount. The Workshop experiments are divided into several groups: habitability, medical, astronaut maneuvering, earth resources measurements, external contamination measurements, materials technology, and science. Solar astronomy and stellar/galactic astronomy experiments will be done with the ATM, and several bioscience experiments will be made in the Apollo spacecraft.

Three NASA Headquarters program offices--Space Science and Applications, Advanced Research and Technology, and Manned Space Flight--plus the Department of Defense, are contributing to the experiment pool. OMSF is managing all experiments, and the Marshall Center is integrator for experiments, except those located in the command/service module.

Workshop Manufacture and Testing

An engineering mockup of the Saturn Workshop was built at the McDonnell Douglas Astronautics Co. facility at Huntington Beach, Cal. The mockup is now at the Marshall Center, being used in design reviews

and development tests of lighting, ventilation, acoustics, and floor and wall layout. Other hardware includes zero gravity and neutral buoyancy simulators at the Marshall Center, and a trainer planned for the Manned Spacecraft Center.

Many of the Workshop's activation tasks have been tested in a neutral buoyancy water tank at MSFC. A pressure-suited man is weighted so that he neither rises nor sinks in water. Thus suspended, he can work in an environment similar to weightless space. Water density tends to hinder movements, but the tests are the best long-term weightless simulation available for stationary operations. The tests show design engineers how well their tools and equipment can be handled in space.

Air Lock Module

The airlock module is made of a load-bearing truss framework and a central compartmented tunnel assembly. The airlock--16 feet, 8 inches long, including the structural transition section--is mounted at the forward end of the Workshop and rigidly attached to the docking adapter. During launch the airlock will be inside a jettisonable payload shroud, attached to a fixed airlock shroud at four mounting points. This airlock shroud remains a part of the orbital assembly and houses the oxygen and nitrogen gas storage tanks.

Four viewing ports, spaced about 90 degrees apart, are located in the transition section (forward end) of the airlock, as are most Skylab controls and displays. The 65-inch-diameter tunnel assembly includes

two internal bulkheads with hatches and a flexible, pressure-tight assembly connected to the Workshop. The tunnel permits intravehicular transfer of crewmen within the pressurized environment of the entire Skylab. The airlock compartment has a Gemini hatch in the tunnel wall to provide crew access to space without depressurization of the Skylab, and is big enough to hold two crew members in pressurized suits with portable life support systems.

The airlock module is the nerve center of the Workshop cluster. It provides storage, distribution and conditioning of the environmental gases, electrical power control and distribution, real and delayed time instrumentation, data management, intercommunication system, ground network to cluster command system, and experiment installation provisions.

Multiple Docking Adapter

The multiple docking adapter is a cylindrical pressure vessel attached to the airlock by the transition section. The MDA contains about 1,500 cubic feet of area for storage and crew operations in orbit. Its main functions are: control station for the ATM, ATM film storage area, and operation site for certain experiments.

Measuring 17 feet in length and 10 feet in diameter, its forward end culminates in an axial docking port; a second docking port projects from the side of the cylindrical section. Both ports are built for Apollo command module docking; the radial port is a backup. Two windows are

located 180 degrees apart on the cylindrical section. One is directly above the ATM port and will be used by the crew to observe ATM operations; the other will be used for earth pointing experiments. All experiments, film and other equipment will be mounted on the internal cylinder wall.

Project Management

The organizations responsible for directing the Skylab Program are the Office of Manned Space Flight and its Skylab Program Office at NASA Headquarters, and the three OMSF field centers: Kennedy Space Center, Manned Spacecraft Center, and Marshall Space Flight Center.

The Marshall Center's Skylab Program Office manages the Saturn Workshop, the Apollo Telescope Mount, the airlock module and the multiple docking adapter. MSFC also has design responsibility for the Workshop, the ATM and the MDA. Management responsibility for the airlock module was transferred to the Marshall Center from the Manned Spacecraft Center in December 1968. This realignment was made to establish a balance between the Apollo and Skylab programs, putting design integration at a single NASA center.

Management responsibilities include systems engineering, development, testing and integration required to assure the compatibility, as an integrated system, of flight hardware and ground support equipment.

The Manned Spacecraft Center is responsible for all manned aspects of Skylab, including crew training and developments for medical and

other experiments. MSC also has charge of mission planning and operations, as in previous manned flight programs. The Kennedy Space Center is in charge of launch operations, including preparation of launch facilities.

Martin-Marietta Corporation, Denver Division, is responsible to MSFC for systems engineering and integration work for Skylab. This includes mission analysis and systems engineering of all flights and integration of experiments and support equipment.

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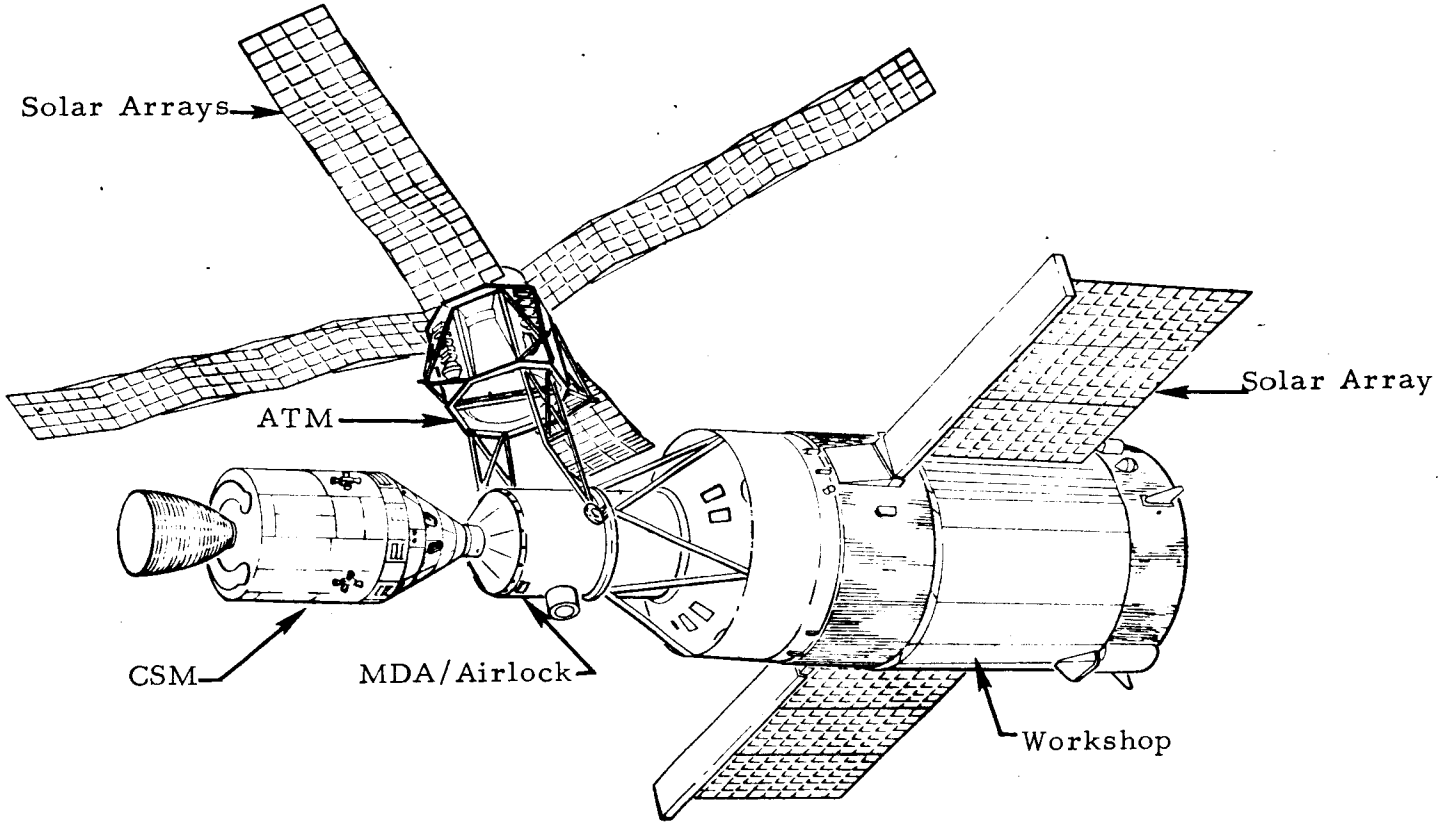
SKYLAB

SATURN WORKSHOP



NASA—MSFC

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April 29, 1970

IMMEDIATE RELEASE

Release No. 80-82

MARSHALL SPACE FLIGHT CENTER, Ala. -- Three aerospace contractors--Lockheed Missiles and Space Co., McDonnell Douglas Astronautics Co. and North American Rockwell's Space Division--have submitted proposals at the request of the space agency for continuation of nuclear shuttle definition studies.

The proposals are presently being evaluated at the NASA-Marshall Space Flight Center.

The nuclear flight system definition studies were started in July 1969. The objective of the studies at that time was to define the system requirements for a nuclear stage to be used primarily as an expendable third stage of the Saturn V launch vehicle. These studies showed that with the development of the nuclear stage, the Saturn V would be capable of injecting 160,000 pounds into a translunar trajectory. This is an increase of approximately 60,000 pounds over the current Saturn V/Apollo system and would make possible the increase of man's capability to remain on the lunar surface for up to 28 days with a single Saturn V launch.

The nuclear flight system definition studies were broadened in October 1969 to include reusable nuclear shuttle concepts as a result of program analyses last year by NASA and by the President's Space Task Group to define an integrated program plan for achieving space goals in the next two decades.

A nuclear shuttle designed to operate between earth orbit and lunar orbit is now being considered. It would be used in conjunction with another (chemical) shuttle which would operate between earth and earth orbit. These two reusable shuttle craft are being considered as a part of an overall transporation system for space exploration.

The nuclear shuttle, once placed in orbit, would deliver payloads to a lunar orbit or other destinations and return to earth orbit. The nuclear shuttle would then be refueled with propellant brought to orbit by the earth orbital shuttle and then be used for additional missions. The earth-to-orbit shuttle would reduce the overall earth orbital transportation costs from $1,000 per pound for the Saturn V system to $100 per pound. With the addition of the nuclear shuttle to the transporation system, the cost of delivering payload to lunar orbit could be reduced from approximately $5,000 per pound for the current Saturn V/Apollo system to approximately $500 per pound for the earth-to-orbit shuttle/nuclear shuttle transportation system.

A variety of nuclear shuttle concepts will be studied under the proposed contract extensions. These concepts will use the NERVA engine which is currently under development by NASA and the Atomic Energy Commission.

North American Rockwell will study a large, 33-foot-diameter nuclear stage which is placed in orbit by the Saturn V and refueled by the earth-to-orbit shuttle. Lockheed will study a completely modular concept in which the earth-to-orbit shuttle is used to transport modules to orbit which are then assembled into the nuclear shuttle system. McDonnell Douglas will study both the 33-foot-diameter system and the modular concepts.

The proposed contract extensions will be for a twelve-month duration including a period for documentation of the final study results.

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May 1, 1970

IMMEDIATE RELEASE

Release No. 70-85

MARSHALL SPACE FLIGHT CENTER, Ala. -- A Saturn V second stage (S-II-13) was successfully captive fired April 30 at the NASA-Marshall Space Flight Center's Mississippi Test Facility.

Duration of the static test was six minutes and seven seconds.

The S-II-13, a liquid hydrogen/liquid oxygen-powered stage, will be the second stage for the Saturn V vehicle scheduled to launch the Skylab. Skylab is the first U.S. embryonic space station now set for launch in late 1972.

There are two remaining second stages yet to be tested in the current series of 15 Saturn V launch vehicles.

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May 8, 1970

APOLLO TELESCOPE MOUNT

The National Aeronautics and Space Administration is developing the Apollo Telescope Mount (ATM) to give solar scientists a look at the sun's activity undistorted by the effects of the earth's atmosphere.

NASA plans to launch the first of its manned solar observatories in 1972. The space agency is joined by the scientific community and industry in developing the highly sophisticated satellite. The project is directed by the NASA-Marshall Space Flight Center.

Five principal investigators, all experts in astronomy and solar physics, have designed five experiments for the first ATM flight. The eight instruments used in these five ATM experiments will obtain measurements of the sun in the extreme ultraviolet and X-ray portions of the electromagnetic spectrum, which cannot penetrate the earth's atmosphere, and obtain pictures of the sun's corona in the white light portion of the spectrum.

The first ATM, a part of the Skylab Program, is a forerunner of more advanced solar and stellar observatories which will provide increased data-gathering capability for astronomers.

Ground-based scientists "see" the sun only in visible light and in portions of the infrared and radio frequencies of the electromagnetic spectrum. Instruments carried by unmanned spacecraft and balloons have been pioneers in spaceborne solar astronomy.

The manned ATM offers opportunities not available with unmanned spacecraft. An astronaut will do tasks requiring judgment to select targets of scientific interest and to point the telescopes. He will control all ATM experiment operations in acquiring the data, including retrieval of films. These operations can be augmented by radio contact with scientists on the ground who can redirect the observing program based on ground data or verbal descriptions from the astronaut crew.

Where ATM Fits in the Skylab Sequence

The Apollo Telescope Mount will be part of a cluster of hardware as shown in the cluster illustration. The cluster includes the Workshop, airlock, multiple docking adapter, the ATM and an Apollo command/service module (CSM). A Saturn V vehicle, using only the first and second stages, will place the complete payload (excluding the manned CSM) into an earth

orbit of about 235 nautical miles altitude. The Workshop portion of the payload is the third stage of the normal Saturn V vehicle. The stage is being modified to provide habitable quarters in which the astronauts will live and work during their stays in space.

The cluster, completely outfitted before launch, will be placed into earth orbit. A day or two later the manned Apollo CSM will be launched by a Saturn IB to rendezvous and dock with the cluster in orbit. The CSM will dock with the forward port of the multiple docking adapter (MDA). After 28 days in earth orbit, the first crew will return to earth in the command module. A month later a second crew will revisit the cluster to conduct experiments for up to 56 days. After a lapse of another month or more, a third crew will be launched as the fourth flight in the series. The CSM will dock with the cluster which still remains in orbit after previous missions.

During the missions, the cluster will be inertially stabilized by the control system on the ATM to maintain the axis of the telescopes along the sun line. The control system consists of two main control loops: the outer loop uses a coarse sun sensor stabilized by three large control moment gyroscopes which provide basic cluster orientation and stability.

The inner loop is a fine pointing system driving the experiment package. This system uses a very precise sun sensor to accurately point the experiments to crew-selected areas on the sun. Stability on the order of plus or

minus 2 1/2 arc seconds is provided by this vernier, or inner loop control system, by counteracting disturbances such as crew motions.

ATM Experiments

Five authorities in astronomy and solar physics are designing the five major experiments for the first ATM mission. These experiments are being developed under the direction of the NASA-Marshall Space Flight Center.

Eight major solar instruments will be used in conducting this investigation. The devices are designed to provide high spatial and spectral resolution in the ultraviolet, X-ray, white light and hydrogen-alpha (6,563 angstrom) bands of the spectrum and are particularly concerned with the active regions on the solar disk or in the corona.

The telescopes are mounted in a 7-foot-diameter cylindrical structure on their unique optical bench structure.

The five principal experiments are the High Altitude Observatory (HAO) white light coronagraph, the Naval Research Laboratory (NRL) ultraviolet spectroheliograph and extreme ultraviolet spectrograph., the Harvard College Observatory (HCO) ultraviolet scanning polychromator spectroheliometer, a Goddard Space Flight Center (GSFC) X-ray telescope and an imaging X-ray spectrographic telescope by American Science and Engineering, Inc.

Dr. Riccardo Giaconni of American Science and Engineering, Cambridge, Mass., is the principal investigator for the X-ray spectrographic telescope. This experiment is designed to obtain X-ray photographs of temporal changes associated with solar activity, including flares, with a spatial resolution of about two arc seconds. It will simultaneously record spectrally dispersed emissions over the range of two to eight angstroms with a resolution of a fraction of an angstrom.

An electronic flare detector, in addition to the main telescope, will give an astronaut a visual indication of flare buildup. This will allow him to select active regions and photograph the flares in the early X-ray rise periods.

James Milligan is the principal investigator for the Goddard Space Flight Center's X-ray telescope experiment. The experiment uses a glancing incidence X-ray and extreme ultraviolet telescope with a resolution capable of recording the solar X-ray distribution over the complete solar disk and near corona in the three to 60 angstroms wavelength region. Information will be recorded on X-ray-sensitive 35-millimeter roll film. There are also two proportional counters to monitor the total solar X-ray flux in the spectral regions of two to eight and eight to 20 angstroms. This data will be pulse-height-sorted and recorded for use by an astronaut for historical observation to identify possible flare precursor activity changes.

Two Naval Research Laboratory extreme ultraviolet experiments will be flown on the ATM. J. D. Purcell of the NRL, Washington, D. C. is principle investigator.

The first of the two instruments, Experiment A, is an extreme ultraviolet spectroheliograph designed to photograph images of the total disk in the various wavelengths between 150 and 650 angstroms. The main elements of the extreme ultraviolet spectroheliograph are a concave grating and a film strip camera. Experiment B, an extreme ultraviolet spectrograph, is designed to photographically record line spectrograms of the solar radiation between 930 and 3,940 angstroms from selected small areas on the solar disk and at different levels across the limb of the sun and into the corona.

An additional part of Experiment B is the extreme ultraviolet monitor. Housed in the same case and closely aligned with Experiment B, it is designed to provide a television representation of the solar image in the extreme ultraviolet, which is used by an astronaut to identify solar ultraviolet features not visible at longer wavelengths. Experiment B also can be commanded by an astronaut to display a television image of the spectrograph slit in white light.

Dr. Leo Goldberg of the Harvard College Observatory, Cambridge, Mass., is the principal investigator for the HCO ultraviolet scanning polychromator spectroheliometer experiment. This experiment acquires its primary data by photoelectric conversion technique with later periodic data transmission to earth receiving stations. The primary instrument scans a 5 x 5 arc minute area of the sun with a 5 x 5 arc second slit simultaneously

measuring the intensity of predetermined spectral lines. An alternate method will spectrally scan a 5 x 5 arc second spot on the solar surface. This instrument measures in the 300 to 1,310 angstrom region of the ultraviolet, searching the chromosphere, photosphere and corona for quiet sun phenomena plus such perturbations as plages, flares, filaments and associated active regions.

Another instrument, the H-Alpha telescope, obtains narrow band photographs of the full solar disc in the hydrogen-alpha (6,563 angstrom) wavelength while a similar image with manual zoom control is available via the television monitor.

Dr. Gordon Newkirk, National Center for Atmospheric Research, High Altitude Observatory, Boulder, Colo., is principal investigator for the HAO white light coronagraph. Its purpose is to monitor the brightness, form and polarization of the solar corona between one-and-one-half and six solar radii from the center of the sun.

The instrument consists principally of three forward (sun direction) external occulting discs, and a modified Lyot coronagraph optical system, drive mechanisms, electronics and a 35-millimeter camera.

Four of the five experiments have instrumentation built by private industry. Ball Brothers Research Corp., Boulder, Colo., is manufacturing instruments for the High Altitude Observatory, the Naval Research Laboratory and the Harvard College Observatory experiments and American Science and

Engineering is building the equipment for its own experiment. The Marshall Space Flight Center is responsible for manufacturing the Goddard experiment equipment. Perkin-Elmer has been awarded the prime contract for building the HCO Hydrogen-Alpha telescope and the main ATM Hydrogen-Alpha pointing telescope.

ATM Operation and Control

The ATM control and display panel, located in the multiple docking adapter, will be the primary work station. From this point the crew will control and monitor the experiments, the pointing control system, the instrumentation and communications and the power system.

A television system will enable astronauts at the work station to see images of the sun recorded by the telescopes. This system consists of five TV cameras mounted in the experiment package, two TV display monitors, and associated equipment mounted on the control console. The TV data will also be transmitted to earth.

Two of the cameras will observe portions of the disc through hydrogen-alpha telescopes. A third camera will observe the whole sun in extreme ultraviolet. The fourth camera will be part of the NRL Experiment B and will observe the spectrograph 3 x 60 arc second slit superimposed on the solar disc in white light with a narrow field of view. The fifth camera will observe the sun's corona, as seen through the white light coronograph

occulting optics. Video switches will allow the operators to observe the same experiment or two separate experiments at one time.

The control station displays allow an astronaut to monitor solar activity and, with investigators on the ground, determine sun features of scientific interest for detailed investigation. This activity not only involves control of which instruments are active and what program is desired, but allows an astronaut to precisely position the instruments on specific regions of solar activity and to traverse those regions.

Film retrieval is an important part of the proposed ATM flight. Astronauts will don pressurized suits to change film outside the spacecraft. The film will be stored in the command module for the return trip to earth.

ATM Physical Description

The ATM is mounted over the forward end of the MDA during launch. The rigid mounting structure swings the ATM 90 degrees to the side of the MDA to its operating position once the cluster has been placed in orbit. The weight of the ATM mission module will be about 22,000 pounds.

The basic structure of the ATM, commonly referred to as the "rack," is an octagonal truss-type structure about 9 1/2 feet deep. It supports the ATM experiment package and experiment support equipment. The 82-inch diameter cylindrical experiment package is 11 1/4 feet long. An interior cruciform structure 10 feet long divides the cylinder into four equal parts. The telescopes of the five ATM experiments are mounted on the cruciform

structure. This cylinder is actively cooled by a liquid coolant, circulated in the cylinder's skin, to maintain an internal surface temperature of 50 degrees F.

A solar shield is located around the sun end of the ATM to protect the rack's electronic components from the sun's direct radiation. Temperatures in about 100 "black boxes" on the rack will be passively controlled.

A gimbal system allows the experiment package to be pointed plus or minus two degrees in pitch and yaw and plus or minus 120 degrees in roll. The system is essentially two large rings, a pitch-yaw and a roll ring, connected by torque motor actuator packages. The roll ring, about nine feet in diameter, is supported by four rack-mounted roller clusters.

Large control moment gyros, being built by the Bendix Corp., will be stabilization actuators for the complete Skylab cluster. Three of the 400-pound gyros will be used on the ATM. Each gyro will generate about 2,000 foot-pound-seconds momentum. The devices have 22-inch wheels which rotate at high speeds, 8,000 revolutions per minute, in pointing and controlling the attitude of the cluster. The sensing elements consist of course sun sensors and rate gyros.

Fine pointing of the experiment package will be achieved by a closed loop torque system operating the fine gimbals under the control of a fine sun sensor and rate gyros.

ATM power will be provided by a combination of solar cells and rechargeable batteries. Four solar cell "wings," measuring about 1,200

square feet in total area, are planned. Electric power generated by the solar cells will be routed to 18 power modules. Each power module has a battery, a battery charger, a regulator and sensing and control circuitry.

ATM Manufacturing and Testing

ATM hardware is being built and will be tested in the Marshall Center's manufacturing shops and test areas. Several component tests are already underway, with tests of an assembled ATM ground test article planned for mid-1970.

An ATM mockup has been at MSFC for several months and is being used in engineering design exercises. There is also a neutral buoyancy simulator at MSFC and many underwater tests have been run.

Vacuum chamber tests of components are underway in the MSFC Astronautics Laboratory. Tests are being conducted in a 12-foot diameter chamber. These include a test of a quarter-section of the ATM experiment cannister, using mockup versions of the Naval Research Laboratory and the American Science and Engineering experiments, and of the fine sun sensor. There has also been a spar thermal deflection test. Control moment gyro tests began in October 1968.

ATM vibration testing is being done on new component equipment. Some prototype and flight models are being tested, as well as a test article. The Astronautics Lab has also done vacuum development testing on a one-quarter segment of the ATM rack. The Lab is also doing component

qualification testing of the ATM control moment gyro in a thermal vacuum chamber.

The deployment mechanism of the ATM solar panels will undergo extensive testing in the MSFC Astrionics Lab. Some testing has been completed on the deployment drive system. A test fixture designed by the Lab will permit the testing of solar panels in simulated zero gravity conditions. The panels will be turned 90 degrees from their normal attitude and rested on air-supported pads during tests.

The MSFC Quality and Reliability Assurance Laboratory has developed a non-destructive test system for locating bond defects in ATM honeycomb solar cell modules.

ATM Project Management

Engineers and scientists at the Marshall Center have engineering responsibility for the ATM, directing development of experiments and integrating the entire system for the NASA Office of Manned Space Flight. Directing the work is the Center's Skylab Program Office. Martin-Marietta Corporation is the Marshall Center's principal contractor for ATM payload integration and experiment management and development.

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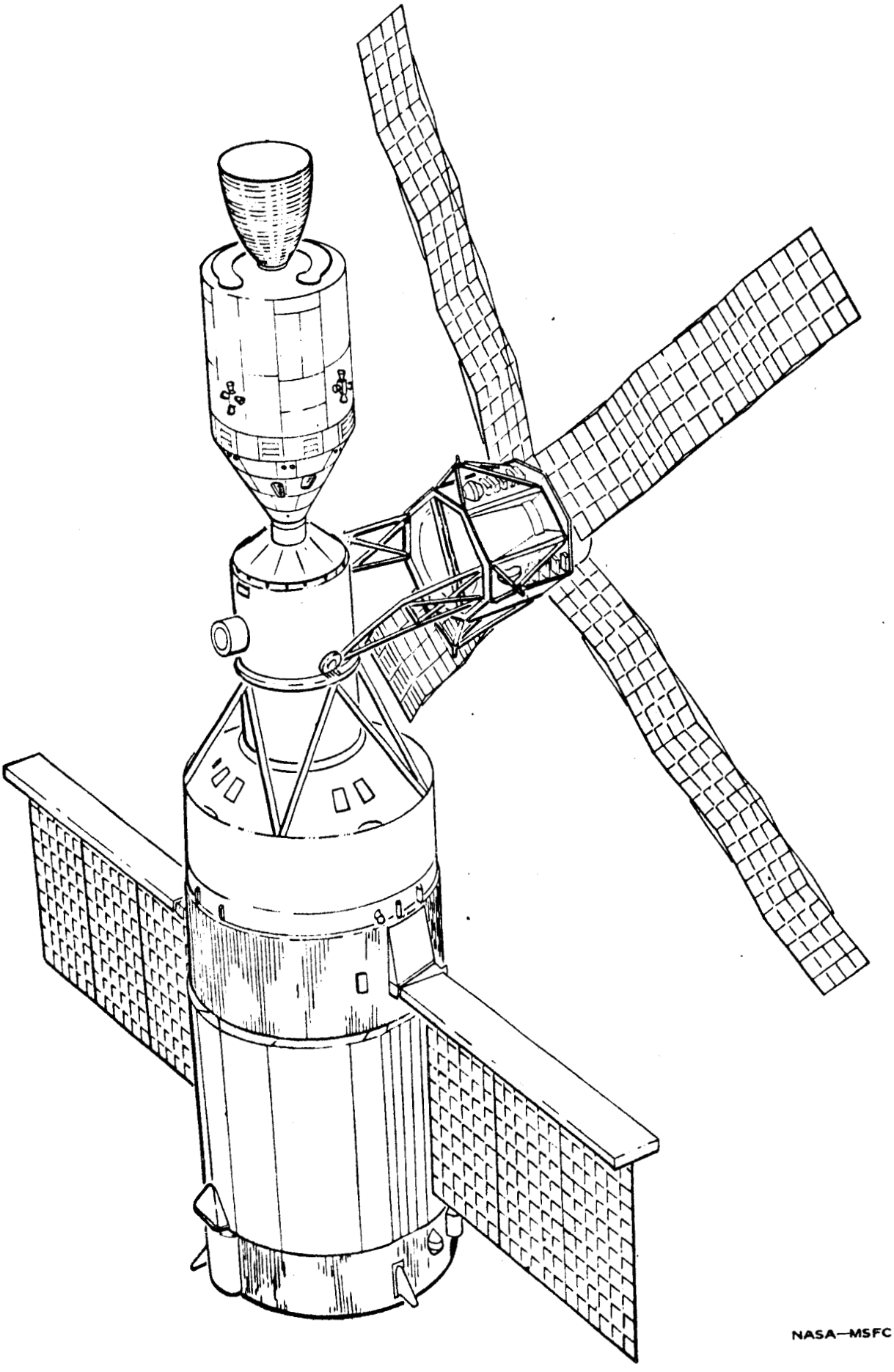

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May 8, 1970

IMMEDIATE RELEASE

Release No. 70-87

MARSHALL SPACE FLIGHT CENTER, Ala. -- Four ground test models of the Apollo Telescope Mount manned solar observatory are taking shape in the largest manufacturing building at the NASA-Marshall Space Flight Center.

Flight versions--one prime spacecraft and a backup--will follow the ground test units.

The ATM observatory is a part of the Skylab scheduled for launch in 1972.

The solar observatories are being built in a large Manufacturing Engineering Laboratory structure (building 4755) which was previously used for Saturn V assembly and early Skylab mockup work.

Marshall Center engineers are now modifying the building for its ATM fabrication role. A "clean room" for dust-free assembly has been erected in the building's high north bay. Extending 32 feet above and 10 feet below the building's present floor, the clean room will have two tooling fixtures for ATM fabrication.

Miller and Berry, a Huntsville construction firm, installed the clean room under a $245,000 contract. One feature of the clean room is that air will "wash" downward over the unit being built.

A second change to the building is the installation of a giant airlock for moving hardware to and from the building without contaminating the air. McAllister and Quinn, Huntsville, recently received a $47,000 contract for installing the 45-foot high airlock.

The installation of the air lock and other changes to the structure will make the entire building essentially a large clean room. Clean room conditions are being achieved by upgrading the airconditioning filter system, painting walls, and restricting traffic to and from the building.

Another ATM-related construction project underway here is in the Quality and Reliability Assurance Laboratory area. Bryson Construction Co., Decatur, is installing another clean room on the south side of building 4708 in what was once a Saturn V pressure test cell. In a nearby area, McAllister and Quinn is building an automatic checkout equipment (ACE) room. This room is being readied for quality checkout of the flight ATM vehicle.

This design and construction work is directed by the Facilities and Design Office of MSFC.

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May 22, 1970

IMMEDIATE RELEASE

Release No. 70-98

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has awarded contracts to three aerospace contractors for continuation of nuclear shuttle definition studies.

Contracts have been awarded to McDonnell Douglas Astronautics Co., $343,000; Lockheed Missiles and Space Co., $282,000; and North American Rockwell Corp.'s Space Division, $245,000.

A variety of nuclear shuttle concepts will be studied under the contract extensions. These concepts assume use of the NERVA engine which is currently under development by NASA and the Atomic Energy Commission.

North American Rockwell will study a large, 33-foot-diameter nuclear stage which would be placed in orbit by the Saturn V and refueled by an earth-to-orbit shuttle which NASA is considering developing. Lockheed will study a completely modular concept in which the earth-to-orbit shuttle is used to transport modules to orbit which are then assembled into the nuclear shuttle system. McDonnell Douglas will study both the 33-foot-diameter system and the modular concept.

The contract extensions are for one year.

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May 25, 1970

IMMEDIATE RELEASE

Release No. 70-100

MARSHALL SPACE FLIGHT CENTER, Ala. -- Anyone who has ever been in the vicinity of a Saturn V launch knows first-hand the awesome rumble and reverberation that shakes the ground, presses against the chest and fills the ears with a roar.

That mighty, low decibel rumble is felt most strongly near the launch pad and in the overall Cape Kennedy, Fla. area. It is also felt as far away as 235 miles, on a barren, marshy island off the coast of Georgia.

That fact was verified by a team of scientists from the NASA-Marshall Space Flight Center, aided by technicians from the University of Alabama in Huntsville (UAH). The team studied seismic vibrations caused by the recent launch of a Saturn V during the Apollo 13 mission; they hope to repeat the experiment in December during Apollo 14.

The purpose of the experiments is to determine how far seismic (i.e., ground) and atmospheric vibrations can be felt from the giant

rocket's firing of its five booster engines, which together generate more than 7.5 million pounds of thrust during liftoff.

The experiments were held on Skidaway Island, located just off the Georgia coast near Savannah. The site was selected because it is empty, flat marshland, well removed from various noises of civilization, and on a direct line-of-sight north of the Kennedy Space Center launch site in Florida.

The University of Georgia has a facility, called the Skidaway Institute for Ocean Sciences, located on the island. Institute officials were hosts for the Marshall Center-UAH group during their visit.

Heading the experimenters is Dr. Ilmars Dalins of the MSFC Space Sciences Laboratory's Plasma and Solid State Physics Branch. Although an atomic physicist, Dr. Dalins has had extensive experience in seismographic work. Eric Flowers of the Marshall Center and three UAH graduate students completed the team.

The investigators placed four seismographs in an almost square array on an open field at Skidaway. One side of the square was parallel to the direct sight line with Cape Kennedy, established by surveying the location.

The team's calculations were proven four days before the Saturn launch when they visually sighted the launch of an Air Force Titan rocket just before 6 a.m.

Two other seismographs were used in the experiment, one buried in the Saturn's crawlerway at KSC, the other buried about a mile from the launch pad. The crawlerway is a three-mile-long special roadway over which launch vehicles are moved from their assembly buildings to the launch pad.

All seismic instruments obtained reasonably good data, according to Dr. Dalins. The Skidaway Island seismometers gave convincing evidence that seismic waves are felt over long distances, at least as far as Savannah, Ga.

One slight disappointment of the study was the slowness of some seismic waves in arriving at the Skidaway instruments. They arrived with the speed of sound that is characteristic of acoustic waves traveling in the atmosphere (more than 1,000 feet per second). Sound waves usually travel through the ground several times faster than through the atmosphere.

Although more investigation is required to completely evaluate this phenomenon, the first impression is that sound waves traveling through the ground somehow coupled with atmospheric waves, slowing the ground vibrations.

A complete explanation of the phenomenon should result from detailed evaluation now being made by Dr. Dalins and his team, with

the cooperation of the Lamant-Doherty Geological Observatory at Columbia University in New York City.

Dr. Dalins has made previous seismic investigations in and around the Kennedy Space Center and at the Marshall Center. The MSFC studies began in 1962 during static test firings of the Saturn I, first of the Saturn family of launch vehicles.

Engineers were interested in how far away reactions to the firings could be felt, and how much disturbance would be noticed by people, or felt by structures, at various distances from the test site.

The MSFC studies proved that Saturn vibrations are low pitched and drop in intensity rather rapidly, although seismic disturbances can be detected more than 20 or 30 miles from the test site.

The Kennedy Space Center studies were designed to measure vibrations felt in the Saturn crawlerway. Seismometers were buried in the crawlerway at separate depths, beside the way and several miles from the launch site. These measurement studies have been made by Dr. Dalins during several Saturn/Apollo launches.

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May 26, 1970

IMMEDIATE RELEASE

Release No. 70-102

MARSHALL SPACE FLIGHT CENTER, Ala. -- A new kind of space vehicle--the space tug--is being studied by National Aeronautics and Space Administration organizations, including the Marshall Space Flight Center, for use in many kinds of future space missions.

Overshadowed in recent months by the larger and more publicized space shuttle and space station designs, the space tug is to be a multi-purpose vehicle that may prove to be just as versatile and valuable as its bigger mates.

Present plans call for the tug to be developed simultaneously with the space shuttle so the two systems can be operational at the same time.

The tug is the only planned space vehicle that would work with and connect all present and future vehicles and systems. Its earliest use would be as the key link between the space shuttle and space station, taxiing cargo and passengers between the two huge craft in Earth orbit.

The Marshall Center's Advanced Systems Analysis Office is working on many possible uses for the space tug, particularly as the logistics connector between the shuttle and station. Other studies are being made at the Manned Spacecraft Center, Houston. Both centers are working together to develop plans for the new vehicle.

The key to the space tug's versatility is its modular design. Three major modules--propulsion, crew and cargo--are visualized by Marshall Center engineers. The modules could be used in many combinations, depending on mission requirements.

The three modules would be built to accommodate several supplementary kits. These would be components such as an astrionics system (for electrical power and guidance), an environmental control system (for life support passenger transport), manipulator arms (for earth or lunar orbital remote handling), or landing legs. Other kits could be developed as needed.

All space tug components would be designed to fit within the space shuttle's cargo bay and be shuttled to Earth orbit. The propulsion module could make long or short trips as required, the crew module could transport up to 12 men, and the cargo module could hold different amounts of supplies and material. This tug assembly would fly from the shuttle, dock with the space station, transfer crews or cargo, fly back into the shuttle's cargo bay and be returned to Earth.

The tug could be launched on missions in several ways. In its earliest application, it would be put into Earth orbit as a space shuttle payload. It also may be launched from Earth as the fourth stage of a Saturn V launch vehicle; further down the decade, it might travel from Earth orbit to the moon as the payload of a nuclear shuttle.

Directed by the Marshall Center, a study is being made by the Boeing Co. on the feasibility of flying the tug's propulsion module as the fourth stage of the Saturn V. Guidance, navigation and control systems (now in the Saturn V instrument unit) would be located inside the propulsion module, which would be the control stage for the entire launch vehicle.

In related tug work, proposals are being evaluated at the Manned Spacecraft Center, Houston, for a nine-month preliminary study of possible missions for the tug. Determination must be made if a single vehicle can do all the tasks proposed for it. The Marshall Center is helping in this evaluation.

Two Marshall Center engineers are responsible for much of the philosophy behind the space tug concept. Alfred G. Orillion is chief of the Vehicle Systems Group, Advanced Systems Analysis Office, and Thomas W. Barrett, also of the Vehicle Systems Group, is project engineer for the space tug and assistant contract representative for the proposed studies being evaluated at the Manned Spacecraft Center.

The tug's propulsion module (PM) is the core of the tug concept. Designed for reuse many times, the PM would have two elements: primary propulsion and secondary propulsion. The primary propulsion element would weigh about 50,000 pounds, burn liquid oxygen and liquid hydrogen, and be used for large velocity changes necessary for planetary injection, braking, Earth orbital plane changes, synchronous orbit, or lunar landings. The secondary element would weigh up to 10,000 pounds, burn nitrogen tetroxide and unsymmetrical dimethyl hydrazine (like the Apollo spacecraft), and could be detached from the primary element for small velocity changes such as maneuvering between the space shuttle and space station.

The crew module (CM) would be much smaller than the PM. Weighing about 10,000 pounds, it could bus 12 men from Earth orbit and return aboard a shuttle; take two men with a manipulator arm kit to service satellites or help assemble a space base or nuclear shuttle in Earth orbit; bus six men to and from lunar orbit aboard a nuclear shuttle; house three or four men on the moon for 30 days or longer; or be used as an escape "lifeboat" for the space shuttle.

The cargo module (CaM) is basically a crew module shell (top and bottom) with an extended cylindrical center section. Its size, therefore, would depend on its cargo. It can transport many kinds of supplies and material from place to place or be used as a satellite repair shop.

Arriving at a satellite, for example, powered by a propulsion module, two astronauts in a crew module could use manipulator arms to grasp and insert the satellite into the cargo module. The module could then be pressurized, the crew could enter it and repair or service the satellite (without going outside the craft). The satellite could also be taken inside the cargo module to a space station for extensive repair.

The space tug propulsion module and kits required for unmanned planetary exploration could be transported to Earth orbit aboard a shuttle and used for trans-planetary injection, singly or in multiple units. Two propulsion modules, for example, could be assembled in Earth orbit, be attached to a payload, and boost that payload toward the planets. One of the modules would separate when its fuel was exhausted and return to low earth orbit for reuse; the other PM would be expendable. Two PM's could also send payloads into lunar orbit, with both modules returning to low earth orbit.

When the nuclear shuttle becomes operational, all space tugs would be interchangeable so they could be used for any prescribed missions. Tugs could be used to remove cargo from a space shuttle and transfer it to a nuclear shuttle for transport from earth to lunar orbit; at the moon, a tug would transfer the cargo from the nuclear shuttle to a lunar orbital station or to the moon's surface.

Many uses for the space tug include: planetary braking for unmanned spacecraft, retrieval of stages to proper locations for maintenance and repair (e.g., nuclear shuttles, other tugs, etc.); specific missions involving plane or altitude maneuvers that may require strap-on tanking; midcourse corrections for manned and unmanned missions; and inter-ship transfer and tug operations between manned Mars ships.

The space tug could help expand lunar exploration. The Saturn V launch vehicle, with the tug's propulsion module as its fourth stage, could be the delivery system for all payloads to the moon, until the nuclear shuttle is operational, probably by the decade's end. The four-stage Saturn would have a lunar orbit payload capacity of almost 100,000 pounds, about 30 percent more than the three-stage Saturn V.

In a typical mission series, two Saturn launches would initiate post-Apollo lunar operations: the first flight would send a 50,000-pound space station and a fully loaded space tug PM into lunar orbit; the second flight would have as payload a manned Apollo command/service module (CSM), a space tug crew module and a cargo module.

A complete space tug (propulsion, crew and cargo modules with a landing leg kit) could then make one round-trip to the moon's surface, supporting three men for up to 30 days. The space station and one PM would remain in orbit. The space station could house six men and

operate autonomously for more than two years; two docked modules could form a 12-man station.

Still another Saturn launch would bring two filled PM's to lunar orbit; the crew could then make two more lunar sorties, reusing the crew module. The astronauts would return to earth in the activated CSM. Other Saturn/tug module trips would expand lunar exploration operations.

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May 26, 1970

IMMEDIATE RELEASE

Release No. 70-103

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has selected McDonnell Douglas Astronautics Co. and TRW, Inc., for final negotiations leading to study contracts for space shuttle auxiliary propulsion system definition.

Each of the companies will receive two contracts for different types of studies. The four contracts are to cost about $1.2 million in total.

McDonnell Douglas' Eastern Division will have Aerojet General Corp. as major subcontractor. TRW's major subcontractor will be Air Research Corp.

The space shuttle is envisioned as a reusable vehicle that will ferry men, supplies and equipment into earth orbit and return to earth for refueling and reuse. The shuttle's main propulsion system definition is being studied under separate contracts.

High pressure and low pressure engine concepts will be studied for use in the shuttle auxiliary propulsion system. Each contractor will study both high and low pressure concepts.

The NASA-Marshall Space Flight Center will manage two of the studies and the Manned Spacecraft Center will manage two. Both centers participated in the evaluation of the proposals.

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June 1, 1970

IMMEDIATE RELEASE

Release No. 70-106

MARSHALL SPACE FLIGHT CENTER, Ala. -- Safety considerations and overcrowding are causing the NASA-Marshall Space Flight Center to relocate several Saturn stages and instrument units that have been assembled, tested and are awaiting launch.

The storage switches involve elements of Saturn IB and Saturn V vehicles. A main storage point has been the Michoud Assembly Facility in New Orleans, a part of the Marshall Center, where the booster stages for both vehicles are assembled.

The New Orleans facility is located in an area of probable hurricanes. Two have hit the facility in the past four years, causing relatively minor damage. After Hurricane Camille last summer, Marshall officials began planning to disperse several stages to other locations as a precaution against possible damage or destruction.

Saturn IB vehicles are the most vulnerable since none have flown since October 1968 and none are scheduled to fly until Skylab missions begin in 1972.

Three Saturn IB boosters are to be moved from Michoud to the Marshall Center here in mid-July.

Two Saturn V vehicles are in storage at the NASA-Mississippi Test Facility, some 30 miles from Michoud.

Three Saturn instrument units, made in Huntsville by the International Business Machines Corp., have been moved from the IBM plant to the Marshall Center, for storage.

The three Saturn IB first stages planned for shipment to the Marshall Center may be moved in one long barge tow--the first such shipment in Saturn history. At MSFC the stages will be placed within a huge tent-like structure erected inside a building. Environmentally controlled, the "tent" will be almost 200 feet long and almost 80 feet wide.

The three instrument units already at MSFC are stored inside an environmentally controlled plastic "hutment" that zips across the top for easy access to the units. Inertial guidance platforms for other IU's are stored at the Huntsville facility of their manufacturer, the Bendix Corp.

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June 2, 1970

IMMEDIATE RELEASE

Release No. 70-107

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has invited industry to submit proposals on a nuclear shuttle system definition study that will also include manned Mars systems requirements.

The first purpose of the study is to define nuclear propulsion system requirements and configuration concepts for manned Mars missions involving full or partial reuse of nuclear propulsion hardware.

Secondly, the study is to define the development and test programs to go from the initial application of a reusable nuclear shuttle (RNS) to the later application as a planetary nuclear propulsion system (PNPS).

The study will also consider the impact on the RNS if the PNPS aspect is designed into the RNS project from the start.

Proposals are due at the NASA-Marshall Space Flight Center by June 8.

During 1969 the concept of an integrated space program received considerable emphasis, and a number of tentative plans evolved. Although no single plan has been accepted for an active program, all follow an overall pattern of manned capability in earth orbital, lunar and planetary exploration activities.

The philosophy of reuse of space transportation systems and commonality of major elements of hardware in these three categories of space exploration is now receiving major emphasis in studies.

One potential mission for a reusable nuclear shuttle would be to propel payloads from earth orbit to the moon and then return to earth orbit for refueling and reuse in similar flights. The same type stage could be used to propel a manned spacecraft from earth orbit onto the trajectory to Mars then return to earth orbit for refueling and reuse.

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June 2, 1970

IMMEDIATE RELEASE

Release No. 70-109

MARSHALL SPACE FLIGHT CENTER, Ala. -- A supplemental agreement has been negotiated between the NASA-Marshall Space Flight Center and International Business Machines Corp. for Saturn launch vehicle flight programming computer requirements and development of computer programs.

The supplement is valued at more than $1.8 million dollars, and extends the work through December 1972.

The supplement is part of IBM's original contract with NASA, awarded in August 1964, to build and support 27 instrument units for Saturn launch vehicles. The instrument unit is the electronic nerve center for Saturn V and Saturn IB vehicles.

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FOR RELEASE:

June 14, 1970

Release No. 70-115

MARSHALL SPACE FLIGHT CENTER, Ala. -- Fifty-nine science and engineering professors from universities and colleges in 26 states were arriving here this weekend for technical study and research at the NASA-Marshall Space Flight Center.

Dr. Eberhard Rees, director of MSFC, will welcome the educators tomorrow. They will also be briefed on NASA and Marshall Center organizations and programs.

Following the presentation, they will be formed into two groups and carry out the Summer Faculty Fellowship programs sponsored by the Space Agency and the American Society for Engineering Education. Auburn University and the University of Alabama conduct the program for Marshall.

One is a research program to be conducted from June 15 to Aug. 21. The second part is a design program which spans 11 weeks.

Those in the Aeronautics and Space Research Program will be given the opportunity to conduct individual research in Marshall Center laboratories.

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The work is to be of mutual interest to the laboratory as well as the faculty member. At the end of the summer, his work will be documented for the use of NASA and his colleagues.

Those in the Engineering Systems Design Program will work on a central theme. They will make a complete systems design of an information management dissemination and utilization network. Such an information system could be used by the Space Agency as well as non-space activities.

Both faculty programs, conducted annually, are designed to enrich each Fellow's background in either engineering science or design. This is to enable each professor to have a better basis for teaching engineering science courses or developing multidisciplinary engineering systems design courses at his home institution.

Summer Faculty Fellows in the research program include:

California--Dr. Leroy W. Bearnson, San Diego State College, San Diego, and Dr. Thomas W. Carpenter, California Polytechnic State College, San Luis Obispo.

Ohio--Dr. Paul X. Bellini, Youngstown State University, Youngstown; Dr. Paul R. Dunlap and Dr. Robert Goyer, both of Ohio University, Athens.

Arizona--Dr. Charles H. Black, Northern Arizona University, Flagstaff, and Dr. Carl R. Zimmer, Arizona State University, Tempe.

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Alabama--Dr. Charles Gibson, Dr. John N. Youngblood, Dr. Charles H. Mullis Jr., Dr. Charles R. Evces and Dr. Julian O. Doughty, University of Alabama, Tuscaloosa; Dr. Robert M. Brown, University of Alabama, Huntsville; Dr. John E. Cochran Jr., and Dr. Leo J. Hirth, Auburn University, Auburn. Dr. William A. McNeill, University of South Alabama, Mobile.

Louisiana--Dr. Courtney C. Busch, Louisiana State University, New Orleans, and Dr. James M. Oliver, Louisiana State University, Baton Rouge.

Texas--Prof. Dwight A. Caughfield, Abilene Christian College, Abilene; Prof. Ira L. Williams and Mrs. Loretta W. Hoover, both of Texas Tech University, Lubbock.

Colorado--Dr. Dara W. Childs, Colorado State University, Fort Collins.

Kansas--Dr. Everett L. Cook, Wichita State University, Wichita; Dr. Robert L. Gorton, Kansas State University, Manhattan.

Tennessee--Dr. Harry L. Deffebach, University of Tennessee, Tullahoma; Dr. Robert L. Reid, University of Tennessee, Knoxville; Prof. Thomas M. West, University of Tennessee, Nashville; Dr. William T. Segui, Memphis State University, Memphis.

Virginia--Dr. James J. Donaghy, Washington and Lee University, Lexington.

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Illinois--Dr. James L. Evers, Southern Illinois University, Carbondale; Dr. Richard S. Tankin, Northwestern University, Evanston; Dr. Timothy N. Trick, University of Illinois, Urbana.

Montana--Dr. John B. Hendricks, Montana State University, Bozeman; Dr. Thomas E. Margrave Jr., University of Montana, Missoula.

Mississippi--Dr. James D. Gassaway and James W. Cook, Mississippi State University, State College; Dr. Robert E. Kelly and Prof. Damon Wall, University of Mississippi, University.

South Dakota--Dr. Ralph C. Huntsinger and Dr. Larry A. Weitzenkamp, South Dakota School of Mines and Technology, Rapid City.

New York--Dr. Albert S. Johnston and Dr. Herbert Tesser, Pratt Institute, Brooklyn.

Indiana--Dr. Richard J. Leake and Dr. Richard E. Saeks, University of Notre Dame, Notre Dame.

Pennsylvania--Dr. Donald F. McLeroy, Lehigh University, Bethlehem.

Iowa--Dr. Bion L. Pierson, Iowa State University, Ames.

Kentucky--Dr. Richard W. Postma, Transylvania College and Dr. Stanley E. Jones, University of Kentucky, Lexington.

Florida--Dr. John W. Sheldon, Florida State University, Tallahassee; Dr. John P. Kerr, University of West Florida, Pensacola; Dr. Ronald E. Smith, University of Florida, Tallahassee.

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Missouri--Dr. Henry A. Wiebe and Dr. Russell A. Primrose, University of Missouri, Rolla.

Minnesota--Dr. Duane A. Dahlberg, Concordia College, and Dr. Dennis Mathiason, Moorehead State College, Moorehead.

New Mexico--Dr. John P. Eddy, New Mexico Tech, Socorro.

Washington--Dr. DeWayne J. Piehl, University of Washington, Seattle.

North Dakota--Vernon C. Schneider, North Dakota State University, Fargo.

West Virginia--Prof. Steven M. Zimmerman, West Virginia University, Morgantown.

Staff members directing the Research Program are J. Fred O'Brien Jr., Auburn University; Dr. Robert R. Head, Marshall Space Flight Center, and Dr. B. F. Barfield, University of Alabama.

Staff members directing the Engineering Systems Design Fellowship Program are Dr. R. I. Vachon, Auburn University; Herman G. Hamby, Marshall Space Flight Center; Dr. James E. Cox, University of Houston; Dr. Russell E. Lueg, University of Alabama, and O'Brien.

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6/11/70

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June 18, 1970

IMMEDIATE RELEASE

Release No. 70-119

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has awarded a $320,000 contract to the North American Rockwell Corp. Space Division for a lunar base synthesis study.

The Downey, Calif., firm was one of 18 aerospace contractors invited to submit bids on the study, which will take 11 months.

Objectives of the study are to define and analyze lunar exploration missions that may be desirable and possible in a long-range program plan, establish respective requirements, and develop conceptual descriptions of semi-permanent lunar surface bases that will allow designated mission objectives to be achieved.

Optimum types of mission support equipment will be derived and operational limitations will be shown in the study.

The study will consider the usefulness of mobile systems for long traverses of the moon's surface, different types of surface drills and other tools and equipment will be examined, and the capabilities of flying

and surface roving vehicles will be related to the needs of different types of missions.

To be considered for long surface traverses will be a combination mobile shelter and laboratory capable of supporting two men on the moon's surface for two weeks.

Conceptual designs of at least two different lunar surface shelters will be prepared. One concept will be derived from a specified space station module, and the other will be designed to function only on the lunar surface with the capability to meet the requirements for a variety of lunar surface missions.

The study will also examine all aspects of operating a semi-permanent lunar surface base without the existence of a lunar orbit space station, operating such a base while a space base is in lunar orbit, missions that could be performed from such a surface base, and surface missions that could be performed from either a lunar orbit station or surface base.

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June 19, 1970

IMMEDIATE RELEASE

Release No. 70-121

MARSHALL SPACE FLIGHT CENTER, Ala. -- Engineers at the NASA-Marshall Space Flight Center have designed the largest solar cell array system for electric power ever devised for a spacecraft.

The arrays will turn sunlight into electric power for the Saturn Workshop and Apollo Telescope Mount, major components of the Skylab cluster to be placed in earth orbit in late 1972.

Each of the solar cell arrays is designed to provide 10,500 watts of power at 55 degrees centigrade while in the sunlight portion of each orbit. This will vary between 58 and 69 minutes.

Essentially no power is generated by the solar cells while the spacecraft is in the earth's shadow. Times in shadow will vary between 25 and 36 minutes.

Whatever power is needed to operate the Workshop and ATM is taken from the arrays. The remainder of the power generated is diverted to battery chargers which keep the nickel-cadmium batteries at full charge and ready for use while the cluster is in the earth's shadow.

The average power consumption of a three-bedroom house is about 4,000 watts. The Skylab power generation systems at peak operation will produce 21,000 watts, or enough for five average houses.

A power conditioning system regulates the Skylab power to a nominal level of 28 volts dc at about 4,000 watts. Losses in the system are due to normal line resistances, battery recharging and losses in the voltage regulators.

Comparing the ATM and Workshop arrays with those of other satellites, the new arrays are by far the largest and most powerful. One Air Force satellite had 356 square feet of cells and the historic Mariner IV had 25 square feet.

With 187 square feet of cell surface area, the Orbiting Astrophysical Observatory had 772 watts of solar array power, or about 300 watts of usable power.

Each of the three Pegasus meteoroid detection satellites was provided with about 86 watts of power by solar cells.

APOLLO TELESCOPE MOUNT

The 18 solar cell panels of the ATM array will weigh 4,000 pounds and the charger-battery-regulator modules (CBRM)--one for each panel--will weigh 1,980 pounds total.

The ATM array is made up of four wings linked in a cross. Each wing has four full panels and a half panel. The wings are folded for launch

and extended by a scissors linkage after reaching orbit, exposing 1,200 square feet of solar cell surface area to the sun.

Each panel has 20 modules of solar cells and each panel is connected to a CBRM. The array is wired to provide 18 separate power sources, each with its own CBRM, so that a failure due to a meteoroid hit or other cause would result in the loss of only one-eighteenth of the array's total power.

ATM panel modules are made up of solar cells of two sizes, those in 180 of the modules being two by two centimeters square and those in the other 180 modules being two by six centimeters. A total of 164,160 individual solar cells are used in the ATM array.

The two-by-two cells are wired 114 in series and six in parallel. The two-by-six cells are wired 114 in series and two in parallel.

Work on the ATM modules began more than two years ago. All have been completed and all have passed rigorous qualification testing. Marshall Center engineers bought the cells from commercial suppliers and manufactured the modules. The CBRM's are now being built. Testing of prototype and flight arrays will be done at the Marshall Center.

The ATM is designed to give space scientists a good clear look at the sun's activities. Orbiting the earth at an altitude of more than 250 miles, the ATM will be above the atmosphere which, heretofore, has dimmed man's view of the heavens.

Seven major experiments are being designed for the ATM mission under the direction of the Marshall Center. Telescopes, cameras and other devices are designed to provide high spatial and spectral resolution in the ultraviolet, X-ray, white light and hydrogen-alpha (6563 angstrom) bands of the spectrum. Scientists are particularly concerned with the active regions on the solar disc and the corona.

The main part of the ATM is a cannister containing the telescopes and associated equipment. It will weigh about 20,000 pounds. It will be mounted on pivot arms so that it can be above the MDA for launch and then pivoted 90 degrees to one side for use in orbit.

SATURN WORKSHOP

A final decision has not been made on the exact number of individual solar cells to be used in the Workshop array, but the array will also expose 1,200 square feet of surface area to the sun's rays.

The Workshop array will consist of two wings that unfold from opposite sides of the main Workshop body. These panels will be wired to provide eight separate power sources.

The Workshop is actually a Saturn rocket stage (S-IVB) converted into a spacecraft. With 10,000 cubic feet of living and working space, it is to be launched in late 1972 by a Saturn V vehicle--first and second stages only.

Astronauts will be launched by a Saturn IB a day later to rendezvous with and occupy the Workshop.

Components of the Skylab cluster in earth orbit will be the Workshop, an airlock, a multiple docking adapter and the ATM. The Apollo command-service module (CSM) carrying the astronauts will dock with the forward end of the docking adapter.

The first crew will use the Skylab for 28 days before returning to earth in the CSM. Two months later a second crew will enter the station for a 56-day stay in space. A third crew will also journey to the Skylab for a 56-day visit. Between visits, the Skylab will be "stored" in earth orbit.

Engineers have designed into the system the capability to transfer power from the ATM to other units of the orbiting cluster if necessary. The capability of reversing this and drawing power from the other units has also been provided.

The Power Branch of the Marshall Center's Astrionics Laboratory has the responsibility of providing the prototype and flight model arrays for the ATM, completed and tested.

The array for the Workshop is being manufactured under contract by the McDonnell Douglas Astronautics Co., the firm which is producing the Saturn Workshop.

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June 26, 1970

IMMEDIATE RELEASE

Release No. 70-129

MARSHALL SPACE FLIGHT CENTER, Ala. -- A NASA-Marshall Space Flight Center executive who has been assigned to NASA Headquarters in Washington since last October has accepted the position in a permanent capacity.

He is Harry H. Gorman, formerly deputy director, management, at the Marshall Center where he had served nearly 10 years. He now serves as deputy associate administrator for manned space flight (management).

Richard W. Cook has been named to fill Gorman's former post at MSFC, pending approval by NASA Headquarters. Cook has served in the post on an acting basis during Gorman's absence.

A native of Illinois, Gorman worked with the Atomic Energy Commission in management positions before joining the space program.

An engineer, Cook also worked with the AEC for many years but served later as a corporate vice president of the American Machine and Foundry Co., before coming to the Marshall Center.

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July 1, 1970

IMMEDIATE RELEASE

Release No. 70-134

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has awarded a contract to Rocketdyne of North American Rockwell for Saturn rocket engine support work.

Rocketdyne will provide operational and flight support and launch site support for H-1, F-1 and J-2 rocket engine programs.

The $22,841,941 contract covers the period July 1, 1970 to June 30, 1971.

Rocketdyne builds H-1, F-1 and J-2 rocket engines for Saturn launch vehicles. All of the rocket engines now required for the Saturn program have been fabricated and delivered to the space agency.

The rocket engines were purchased from Rocketdyne under separate contracts.

The Marshall Space Flight Center directed the development of Saturn launch vehicles and will administer this contract.

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July 7, 1970

IMMEDIATE RELEASE

Release No. 70-135

MARSHALL SPACE FLIGHT CENTER, Ala. -- Three technical groups will discuss a wide range of space agency projects at meetings starting today at the NASA-Marshall Space Flight Center.

Topics include future space agency projects, Skylab and the High Energy Astronomy Observatory.

Dr. Wernher von Braun, NASA deputy associate administrator for plans, and eight other Headquarters officials are here for discussions and briefings on several scientific projects being conducted at the Marshall Center.

The visitors are participating in detailed briefings on several future projects that are planned as part of the space shuttle and space station programs now being studied by NASA field centers and contractors.

Subjects included in the agenda are discussions of scientific payload planning for manned Earth orbital missions; experiment module concept

study; an international space station; phased shuttle development; space biology definition studies; cryogenic insulation development; and materials processing in space.

A two-day Skylab program review also starts today at the Marshall Center.

The conference participants will review the past Skylab work, present status and future activities.

Skylab program officials attending the review include Charles Mathews, deputy associate administrator for the NASA Office of Manned Space Flight (OMSF); Maj. Gen. James W. Humphreys, Jr., director of space medicine in OMSF; William Schneider, director of Skylab Program Office, OMSF;

Christopher C. Kraft, Jr., deputy director of Manned Spacecraft Center; Dr. C. A. Berry, MSC director of Medical Research and Operations; Astronaut Walter Cunningham;

Miles Ross, deputy director for center operations at Kennedy Space Center; and Robert Hock, acting deputy director of Apollo-Skylab Programs at Kennedy Space Center.

Representatives of industry, universities and government are participating in a three-day meeting starting today on the High Energy Astronomy Observatory (HEAO).

Approximately 60 potential investigators are attending the meeting.

The HEAO is a proposed stellar astronomy satellite which would carry experiments provided by experts in the scientific community. HEAO is being planned for launch in 1974. The Marshall Center is directing the planning of the HEAO satellite.

The meeting ends Thursday.

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July 28, 1970

IMMEDIATE RELEASE

Release No. 70-146

MARSHALL SPACE FLIGHT CENTER, Ala. -- Approximately 175 representatives of government and industry are participating in a Skylab airlock/multiple docking adapter crew station review this week in St. Louis, Mo.

The week-long review, which ends Friday, is being conducted at the McDonnell Douglas Astronautics Co.

Topics being discussed include storage areas, equipment and crew operation. Astronauts attending the review are conducting "walkthroughs" of airlock and multiple docking adapter mockups.

The Skylab is the space agency's embryonic space station scheduled for launch in 1972. The airlock and multiple docking adapter are major elements of the Skylab cluster which will include a large solar observatory and crew quarters for long stays in space.

-more-

McDonnell Douglas is developing the airlock. The multiple docking adapter structure is being built by the NASA-Marshall Space Flight Center and Martin Marietta, Denver Division, is integrating equipment and experiments.

F. M. Drummond, manager of the Airlock/MDA Project Office at the Marshall Center is attending the crew station review. Herbert Wiggins, senior project engineer in the Airlock/MDA Project Office's Test Branch, is in charge of crew operations for the review.

The Skylab development is being directed by the Marshall Center.

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July 30, 1970

IMMEDIATE RELEASE

Release No. 70-149

MARSHALL SPACE FLIGHT CENTER, Ala. -- A Saturn V ground test booster stage (S-1C-F) will be shipped Aug. 2 from the NASA-Marshall Space Flight Center to its Michoud Assembly Facility at New Orleans. There it will be thoroughly inspected to determine the effects of long-term storage on launch vehicle stages.

Because of delays in the Apollo program's launch schedule, some Saturn stages must be stored for several years. MSFC management wants to know more about the effects of such storage on the stages.

This stage, which has no engines or propellant lines, was built five years ago for use in the testing of ground facilities, mainly the launch equipment at the Kennedy Space Center, Fla.

The stage will be checked by the Boeing Co., prime contractor, to determine what effect aging and unprotected storage have had on its structural integrity.

Information gathered during the examination will also help NASA assess the feasibility of refurbishing and completing the S-1C facilities vehicle as a flight stage. This possibility is being considered as a means of obtaining an additional stage for future missions.

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For Release:

August 2, 1970

Release No. 70-150

MARSHALL SPACE FLIGHT CENTER, Ala. -- An Apollo Telescope Mount solar observatory will be subjected to simulated space conditions in a month-long series of unmanned tests beginning today (Aug. 2) at the NASA-Manned Spacecraft Center in Houston.

The Apollo Telescope Mount (ATM) thermal systems unit has been installed in a large vacuum chamber used for Apollo spacecraft testing.

A total of 30 Marshall Space Flight Center engineers and technicians are conducting the test series with MSC.

Built at the Marshall Center, the ATM thermal systems unit was flown to the Houston space center on June 1. Test preparations and equipment calibration have been conducted since the ATM's arrival at MSC.

Test personnel began pumping the test chamber down to a simulated space vacuum environment on July 22. Tests, expected to end by Sept. 1, will simulate the alternating hot and cold conditions the flight model will experience as it moves from the sun's direct rays into the earth's shadow.

Eugene Cagle, MSFC's ATM engineering manager, is heading the ATM Test Review Board at Houston; and Dewey B. Channel, Quality and Reliability

-more-

Assurance Laboratory, is the test conductor. Engineers and technicians representing several other MSFC laboratories and offices are also participating.

The ATM prototype and flight ATM, both of which are being fabricated at MSFC, will be flown to Houston for a series of tests in the same vacuum chamber.

The ATM will have a cluster of telescopes and other scientific instruments which will be used to study the sun from Earth orbit -- above the distorting effect of the atmosphere. A part of the Skylab cluster of spacecraft, the ATM is scheduled for launching in 1972.

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August 3, 1970

IMMEDIATE RELEASE

Release No. 70-152

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has awarded a contract modification to Martin-Marietta Corp. for work on the Skylab program.

The $13,460,726 contract is for continuing work on the Skylab's multiple docking adpater (MDA). The work is being done by Martin-Marietta's Denver facility.

This modification covers design, development, fabrication, assembly, integration and test of the multiple docking adapter equipment. The basic docking adapter structure is made by the Marshall Center.

Martin is the prime contractor to the Marshall Center for the Skylab program payload integration. Skylab includes the first U. S. embryonic space station and manned solar observatory. NASA plans to launch the Skylab in 1972.

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August 14, 1970

IMMEDIATE RELEASE

Release No. 70-160

MARSHALL SPACE FLIGHT CENTER, Ala. -- Employees of the NASA-Marshall Space Flight Center were told by Director Eberhard Rees today that the number of MSFC employees to be released in a NASA-wide manpower reduction has been cut to 121.

Letters to all employees affected -- those to be released and those whose assignments will change because of personnel shifts within the center -- will go out Monday, August 17, Dr. Rees said in a letter to workers.

He noted that Marshall was told last month to reduce by 190 positions, to 5,804 permanent jobs. Since that time, 69 employees have retired, which reduced the number to be released by the same figure.

Dr. Rees pointed out that many of these retirees took their retirement earlier than planned specifically to reduce the number of fellow employees who would be reduced, and expressed his appreciation.

"While this is an improvement in our overall position, I am acutely conscious that this is small consolation to 121 of our coworkers," the director wrote.

Dr. Rees pointed out that he and other Marshall officials were "eager to minimize hardship on the affected workers," and have taken several steps to that end.

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A "vigorous outplacement program" will be operated for those who receive separation notices or who are reduced more than one grade in pay. "Over 500 federal agencies and commercial firms are in the process of being invited and urged to interview MSFC employees for new positions," he said. The program will operate for several weeks. Recruiters from other agencies and firms will begin interviews August 26.

To assist in this placement service, employees who are to be separated or reduced two grades or more will receive a personal data form which may be completed and returned to the MSFC Manpower Office. Those forms will be made available to the various recruiters at the outplacement center.

In addition, a general counseling session will be conducted by a regional Civil Service Commission representative from Atlanta, August 21, in Morris Auditorium. There affected employees can learn details of their rights, and procedures to be followed "in order to satisfy any doubts any employee might have," Dr. Rees said.

The director also pointed out that all affected employees and their supervisors have the right to inspect the Retention Register, the principal document used in determining who is separated and who has retreat or "bumping" rights.

The register will be available the day after the issuance of letters. Personnel management specialists will be on hand to explain the register and counsel employees.

"It is our aim to reduce to the absolute minimum the impact of the reduction in force on our employees and their families. We couldn't possibly make it pleasant, but we'll do everything possible to minimize hardship for you who have been our valued and respected fellow workers," Dr. Rees concluded.

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August 17, 1970

IMMEDIATE RELEASE

Release No. 70-162

MARSHALL SPACE FLIGHT CENTER, Ala. -- Manufacture of the fifteenth and final Saturn V booster stage (S-IC-15) has been completed by its builder, the Boeing Co., at the NASA-Marshall Space Flight Center's Michoud Assembly Facility at New Orleans.

The stage is being shipped today by barge to the Marshall Center's Mississippi Test Facility where it will be prepared for a static test firing in late September. S-IC-15 is scheduled to boost the Apollo 19 moon landing mission in 1974.

The S-IC program began in December 1961 when Boeing was selected as prime contractor. The first two flight boosters and two ground test vehicles were assembled and tested by the Marshall Center; all further assembly was done by Boeing at the Michoud plant under MSFC's direction. Static test firings have been conducted at the Mississippi facility since 1966.

-more-

Eight of the 15 S-IC stages have been flown to date as boosters for Apollo Program missions. Six of these vehicles carried astronaut crews into space; two were unmanned flights to test the Saturn V and the Apollo spacecraft.

The seven remaining S-IC boosters are at three NASA locations: S-IC-9 and S-IC-10 are at the Kennedy Space Center, Fla. S-IC-9 is stacked with its sister stages -- second (S-II) and third (S-IVB) stages -- awaiting the launch of Apollo 14 next January; S-IC-10 is assigned to the Apollo 15 mission.

S-IC-11 and S-IC-12 are at the Michoud facility, where they will remain in storage until needed for future space missions. S-IC-13 and S-IC-14 are stored at the Mississippi facility.

S-IC-15, after its static test firing and acceptance by the Marshall Center as flight-ready, will be returned to Michoud for final checkout and storage.

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August 26, 1970

IMMEDIATE RELEASE

Release No. 70-166

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has issued a modification to a contract held by International Business Machines Corp. for changes to digital computers.

The computers involved are to be aboard the Apollo Telescope Mount, a major component of the Skylab. Set for launch into Earth orbit in late 1972, the Skylab consists of the Saturn Workshop, airlock module, multiple docking adapter and the ATM.

The modification, in the amount of $7,932,440, is to cover changes required when the basic concept for the Workshop was altered in 1969. Originally the ATM was to consist of a rack holding the telescopes and other equipment and the ascent stage of an Apollo lunar module.

In the new concept, the ascent stage has been deleted. The rack will be connected with the multiple docking adapter by arms that will allow the ATM to be launched atop the cluster and then pivoted to one side when the Skylab reaches Earth orbit.

The NASA-Marshall Space Flight Center is responsible for Skylab development. The Skylab will be used by the first crew for 28 days and by two subsequent crews for 56-day stays.

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August 27, 1970

IMMEDIATE RELEASE

Release No. 70-169

MARSHALL SPACE FLIGHT CENTER, Ala. -- Several NASA-Marshall Space Flight Center engineers will return here late Friday following a week of testing Skylab program "hardware" in simulated weightlessness aboard an Air Force KC-135 four-engine jet research aircraft.

The plane picked up the Marshall Center men and their equipment Monday (Aug. 24) at the Huntsville-Madison County Airport. This is the first time the research craft, based at Wright-Patterson Air Force Base, Dayton, Ohio, has started such tests from Huntsville. This series of tests ends Friday.

MSFC engineers and technicians participating in the flights include Bob Shurney, Charles Lewis, Bob Hall and Ray Edmondson, MSFC Astronautics Laboratory; Dr. Dan Hale, Space Sciences Laboratory; and Glenn Dobbs and Jim Martin of the Manufacturing Engineering Laboratory. Several contractor employees are also taking part.

Skylab hardware being tested in the simulated space flights is located in the Apollo Telescope Mount's center work station mockup.

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The tests include operation of flight configuration doors for film cassette compartments, retrieval and replacement of film cassettes, and evaluation of handrails and foot restraints.

A lunar soil penetration experiment is also being conducted aboard the KC-135 aircraft for Dr. Nicholas C. Costes of Space Sciences Laboratory. Dr. Costes, a soil mechanics authority, is studying the load bearing characteristics of lunar soil and how lunar roving vehicle wheels will perform on the moon.

One primary reason for flying zero gravity simulation tests is to evaluate flight hardware which the astronauts use during a space mission. Systems operated in weightlessness are designed differently than for Earth-bound use and must be tested in zero gravity to verify that they will work on a space flight.

The KC-135 aircraft is flown in parabolas, or long roller-coaster-type arcs, during these flights. About 30 seconds of weightlessness are achieved on each parabola. This technique comes closer to duplicating the characteristics of actual zero gravity found in space than any other technique. The space agency has been flying such zero gravity simulations since the Mercury Program.

To fly the zero gravity maneuver, the KC-135 pilot starts at 24,000 feet of altitude and a speed of more than 500 miles an hour.

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The plane climbs for about eight seconds and achieves a 50 degree climb angle. At the end of the pullup, the plane coasts for the next 30 seconds, flying a parabolic trajectory. At the top of the parabola, the plane is at approximately 34,000 feet. After the 30 seconds of zero gravity, the pilot pulls his plane out of the dive at approximately the altitude he started.

A typical zero gravity simulation test is designed to take between two and three hours or approximately 40 parabolas.

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August 31, 1970

IMMEDIATE RELEASE

Release No. 70-172

MARSHALL SPACE FLIGHT CENTER, Ala. -- The North American Rockwell Corp. has been awarded two modifications to its basic contract for the second (S-II) stage of the Saturn V launch vehicle. The modifications were approved by the NASA-Marshall Space Flight Center, manager of Saturn V production.

The first modification, valued at $1,768,228, covers changes to the basic contract, originally awarded in 1962, for the manufacture and test of 15 S-II flight stages for the Saturn V. The amendment was due to stage design changes.

The second modification is for an analysis by North American to identify the S-II's capabilities in launching possible space station missions, and to determine what production impacts would result from space station mission studies being conducted by the Marshall Center. This modification is valued at $2,429,005, and the work is to be completed by Mar. 31, 1971.

The work on the first modification is being conducted at North American's plant at Seal Beach, Calif., while work on the second is being done at Seal Beach and the Marshall Center's Mississippi Test Facility, Hancock County, Miss.

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September 1, 1970

IMMEDIATE RELEASE

Release No. 70-174

MARSHALL SPACE FLIGHT CENTER, Ala. -- A full-scale mockup of a detachable, free-flying experiment module for an Earth orbit space station has arrived at the NASA-Marshall Space Flight Center.

The mockup consists of a 15-foot diameter cylinder with a 10-foot diameter cylinder extending from it. Total length is 24 feet. Another cylindrical section will be added to the larger end later, a housing for telescopes.

The interior of the mockup has an efficient arrangement of controls and experiment equipment, leaving room for scientists to move about in the module.

Workmen from the Martin-Marietta Corporation's Denver plant, where the module was manufactured, are installing items removed from the exterior for shipment, such as antennae and auxiliary propulsion system housings.

The module will become a part of a full-scale space station mockup now being prepared at the Marshall Center. The full station mockup is expected to be completed by December.

The experiment module mockup began its trip by truck from Denver. It was routed south of Oklahoma because it was too large for state officials to approve moving it by highway in that state.

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It was loaded onto a barge at the Dandanelles on the Arkansas River northeast of Ft. Smith because it was too large to clear the highway bridge at Memphis.

The barge moved on the Arkansas, Mississippi, Ohio and Tennessee Rivers in reaching its destination near Huntsville, Ala.

Engineers use full-scale mockups in proving design fits and in human factors engineering work -- interfacing man with spacecraft for the most efficient arrangement of equipment.

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September 1, 1970

IMMEDIATE RELEASE

Release No. 70-176

MARSHALL SPACE FLIGHT CENTER, Ala. -- A Skylab payload "shroud" or nose cone will be tested in a large vacuum chamber at the NASA-Lewis Research Center later this year by the NASA-Marshall Space Flight Center.

The payload shroud is a cylindrical structure which will be mounted above the Skylab workshop atop a Saturn V vehicle. The structure, manufactured in four panels, will enclose the Apollo Telescope Mount, multiple docking adapter and airlock during launch.

The structure will be tested at Lewis' Plum Brook Space Power Facility starting in November. Work is expected to continue into January at the 100 by 120 foot vacuum chamber.

McDonnell Douglas Corp. is manufacturing the 56-foot long payload shroud at its Huntington Beach, Calif., facility. It will be moved to the Cleveland space center in the fall.

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Purpose of the tests is to determine the attitude and velocity of the shroud's four panels as they are ejected in a simulated space vacuum. The 6,000 pound panels will be blown apart by an ordnance network. Two tests are planned.

Special test facilities being fabricated for the tests include four 75-foot towers, catch nets and four hydraulic cylinder systems. The towers will serve as posts to suspend the nylon catch nets. The hydraulic cylinder systems are designed to slow down and stop the shroud sections after they have been blown clear of the payload and hit the nets.

Eighteen high-speed cameras and other instrumentation will record the ejection tests.

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September 2, 1970

IMMEDIATE RELEASE

Release No. 70-178

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has issued a modification to an existing contract with the McDonnell Douglas Astronautics Co. for Skylab program work.

The modification is to pay for the conversion of the original orbital workshop that was to be launched by a Saturn IB rocket to a completely outfitted workshop to be launched by a Saturn V.

The original contract with the firm was for $97,340,000 and called for one orbital workshop and one backup. The modification adds $60,918,000.

Originally the plan was to launch the second stage (S-IVB) of a Saturn IB into earth orbit. The S-IVB would be filled with fuel so that it could propel itself into orbit.

Astronauts launched by a second Saturn IB would then rendezvous with the empty stage and convert it into living and working quarters.

-more-

In 1969 a decision was made to outfit an S-IVB on the ground and launch it ready for use. Launch vehicle for this new version is the Saturn V.

Components to be launched by the Saturn V include the Saturn Workshop, airlock module, multiple docking adapter and Apollo Telescope Mount. The crew is to be launched by a Saturn IB a day later.

Set for launch in late 1972, the Skylab will be used 28 days by the first crew and 56 days by each of two subsequent crews. The NASA-Marshall Space Flight Center is responsible for Skylab development.

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September 8, 1970

IMMEDIATE RELEASE

Release No. 70-181

MARSHALL SPACE FLIGHT CENTER, Ala. -- The flight design of the Saturn Workshop, a part of the Skylab program, will be accepted in a series of important reviews scheduled for the next few weeks at the NASA-Marshall Space Flight Center and Huntington Beach, Calif.

Government engineers, astronauts and industry representatives will determine if changes are necessary before the final approval is given for completing the flight workshop now scheduled for launch into earth orbit in 1972.

First in the review series will be an astronaut procedures review Sept. 9-10 at the Marshall Center. Astronauts will study many proposed workshop procedures in a mockup.

A critical design review will be conducted Sept. 14-18 at the McDonnell Douglas Astronautics Co. facility at Huntington Beach, Calif. McDonnell Douglas is manufacturing the workshop for the

-more-

space agency. More than 200 government and industry representatives are expected to participate in the critical design review.

A workshop crew station review will be held Sept. 21-24 at the Marshall Center. Astronaut crewmen will "walk through" many of the Skylab tasks in this review.

Results of the reviews will be considered in a Workshop Critical Review Board meeting Oct. 2 at Huntington Beach, with Leland Belew, manager of the Skylab Program Office at the Marshall Center, presiding. Many of the same participants will have taken part in a preliminary review of the results Sept. 28-29 at Huntington Beach, with William K. Simmons, Jr., manager of the workshop project under Belew, acting as chairman.

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September 8, 1970

IMMEDIATE RELEASE

Release No. 70-182

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has issued a supplemental agreement to the McDonnell Douglas Astronautics Co. in the amount of $97,057,455 for S-IVB program realignment.

The basic contract, with a value of $1,026,393,830, covered the furnishing of the S-IVB stages for Saturn IB and Saturn V. The supplemental agreement adjusts the contract as a result of schedule stretchouts.

Costs will cover storage of completed stages, maintenance of ground support equipment, tooling and facilities over an extended period, and maintaining engineering capability.

Period of performance under the agreement is Dec. 15, 1967 through July 31, 1972. The contract is administered by the NASA-Marshall Space Flight Center which is responsible for Saturn vehicle development.

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September 10, 1970

IMMEDIATE RELEASE

Release No. 70-183

MARSHALL SPACE FLIGHT CENTER, Ala. -- Ball Brothers Research Corp., Boulder, Colo., has received a $195,000 space agency contract to study a solar telescope for possible inclusion in a manned solar observatory on a future flight opportunity.

The six-month definition study was awarded by the NASA-Marshall Space Flight Center on Sept. 3.

NASA's first manned solar observatory (Apollo Telescope Mount, ATM) is scheduled for launch in 1972 as an element of the Skylab cluster. This ATM, which will contain solar experiments designed by five principal investigators, is being built at the Marshall Center.

The space agency has asked Ball Brothers to define requirements for a 26-inch solar telescope as a major new experiment to be included in a follow-on observatory. Dr. Harold Zirin of the California Institute of Technology would be the principal investigator for the new photo heliograph. Other equipment being considered for the follow-on observatory will include experiments currently in existence or under development.

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September 10, 1970

IMMEDIATE RELEASE

Release No. 70-184

MARSHALL SPACE FLIGHT CENTER, Ala. -- A test model of the Apollo Telescope Mount solar observatory is being returned to the NASA-Marshall Space Flight Center from the NASA-Manned Spacecraft Center where it recently underwent extensive thermal vacuum chamber tests.

The ATM thermal systems unit is being barged to Huntsville from Houston. Upon arrival here in late September, the model will be disassembled and used in other test programs.

The unit's rack, without the experiment canister, will be converted by the Marshall Center into an astronaut trainer. This trainer will be sent back to the Manned Spacecraft Center for use by Skylab crewmen there. The experiment canister will be used in further environmental control system evaluations here.

Thermal vacuum chamber tests of the ATM test model were

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completed on Aug. 17, well ahead of schedule, in the MSC Apollo vacuum test chamber. The ATM prototype and flight units, both of which are being fabricated at the Marshall Center, will be flown to Houston for a series of tests in the same vacuum chamber.

The ATM will have a cluster of telescopes and other scientific instruments which will be used to study the sun from Earth orbit -- above the distorting effect of the atmosphere. The ATM is scheduled for launching in 1972 as a part of the Skylab program.

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September 21, 1970

IMMEDIATE RELEASE

Release No. 70-189

MARSHALL SPACE FLIGHT CENTER, Ala. -- A Saturn workshop crew station review begins today at the NASA-Marshall Space Flight Center.

The Saturn workshop is a part of the Skylab program.

A group of nine astronauts headed by Richard Truly is participating in the week-long review being conducted in a mockup here.

Government and industry engineers will monitor the astronaut crewmen's progress and comments as they "walk through" many of the workshop tasks. Medical experiments scheduled for the Skylab flight will be reviewed on Thursday and Friday.

This crew station review follows a critical design review conducted Sept. 14-18 at the McDonnell Douglas Astronautics Co. facility at Huntington Beach, Calif. McDonnell Douglas is manufacturing the workshop for the space agency.

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Results of the critical design and crew station reviews will be considered in a Workshop Critical Review Board meeting Oct. 2 at Huntington Beach, Calif.

Results of these reviews will be used to determine if changes are necessary before the final approval is given for completing the flight workshop now scheduled for launch into earth orbit in 1972.

The Saturn workshop will accommodate three astronauts for periods up to eight weeks. The Marshall Center is directing development of the workshop.

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September 24, 1970

IMMEDIATE RELEASE

Release No. 70-194

MARSHALL SPACE FLIGHT CENTER, Ala. -- A pre-proposal conference opened today at the NASA-Marshall Space Flight Center's Michoud Assembly Facility for firms interested in providing support services at the New Orleans space facility.

Thirty representatives of 12 companies are attending the two-day meeting.

Proposals for the Michoud support services contract are scheduled to be received Oct. 19, 1970.

Mason Rust is the present support services contractor for the Michoud Assembly Facility and its nearby Computer Operations Office at Slidell, La. The Mason Rust contract is scheduled to expire on Jan. 31, 1971.

Mason Rust received the contract Dec. 29, 1961 and now has 493 employees doing the work.

-more-

Support services at Michoud include transportation, communications, security, medical, photography, plant maintenance and engineering, reproduction, janitorial services and fire protection.

The Marshall Center held a pre-proposal conference at the Computer Operations Office in Slidell on Sept. 18 for firms interested in bidding for the computer services contract there. These firms were also requested to make proposals for support services work at Slidell. Representatives of twenty-five firms attended the conference. The computer services contract is held by Service Technology Corp., a subsidiary of Ling-Temco-Vought. This contract expires Jan. 31, 1971.

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September 25, 1970

IMMEDIATE RELEASE

Release No. 70-196

MARSHALL SPACE FLIGHT CENTER, Ala. -- Experiment module concepts were discussed by representatives of the space agency and Convair Division of General Dynamics this week (Sept. 23) at the NASA-Marshall Space Flight Center.

Convair engineers presented the results of a "Phase A" experiment module concepts study conducted for the Marshall Center. These modules are being studied for possible use with the proposed space station.

Three French representatives of the European Space Research Organization also attended the meeting. They were Jean Legarde, Jacques Collet and Mrs. Arlette Lemarchand.

The experiment module would be an extension of the space station which could be outfitted on the ground and transported into space by a shuttle vehicle. Modules which can be attached to the space station or be allowed to orbit near the space station are being

-more-

studied. Free-flying modules for astronomical and other similar experiments will depend on the space station for repair, maintenance and operation.

Max E. Nein, technical director of the program in MSFC's Program Development directorate, said the experiment module is attractive to the European scientific community because a country desiring to participate could build a module complete with experiment package or could build an experiment package for integration into a U.S. module. By choosing either alternative, the participant could manage a complete space project .

"Phase A" studies of this type are concerned with establishing the feasibility of a project.

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September 28, 1970

IMMEDIATE RELEASE

Release No. 70-199

MARSHALL SPACE FLIGHT CENTER, Ala. -- The last captive firing of a Saturn V first (S-IC) stage is scheduled for 3 p.m. Sept. 30 at the NASA-Mississippi Test Facility.

The static test of the fifteenth Saturn V booster (S-IC-15) is the last in a series of ground tests which flight certify the stages for the nation's Apollo program.

Boosters static tested at the Mississippi Test Facility include those which have propelled four manned Apollo spacecraft to the moon. One of these flights was the first lunar landing mission made by Astronauts Neil Armstrong, Edwin E. Aldrin, Jr. and Michael Collins on July 16, 1969.

The Boeing Co. manufactures the S-IC stages for the space agency at the Michoud Assembly Facility in New Orleans, La. The first of the Boeing-built boosters (S-IC-3) was captive fired in 1966

-more-

at the Marshall Space Flight Center. The aerospace firm has built 13 flight stages and two ground test versions.

Captive testing of the Saturn V first stages began at MTF May 16, 1967. Since that time, a total of 11 additional stages were acceptance fired in MTF's role to test, checkout and flight certify stages and engines for manned lunar launches.

Saturn V second stages are also tested at MTF. The final test in that series is scheduled for late next month.

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October 6, 1970

IMMEDIATE RELEASE

Release No. 70-206

MARSHALL SPACE FLIGHT CENTER, Ala. -- Roadbuilders may be able to pave better highways through the use of an instrument originally developed by engineers at the NASA-Marshall Space Flight Center for the U. S. space program.

The device is a gauge for measuring the thickness of concrete paving material on highway roadbeds. It is an adaptation of similar gauges used at the Marshall Center during the last decade to measure paint thicknesses on the metal surfaces of launch vehicles, and to measure the thickness of foam insulation in the Saturn V launch vehicle's second (S-II) stage.

"The problem," said Jim Wiggins of the MSFC Technology Utilization Office, "is to be able to know with reasonable reliability the depth of the concrete you are pouring. Until now, the only ways of determining this are expensive and cumbersome. This device holds promise of solving the problem."

-more-

Experimental development has been done by Marshall Center engineers Robert L. Brown, Quality and Reliability Laboratory, and William McCampbell, Manufacturing Engineering Laboratory. Development continues on new uses for the instrument.

The Pennsylvania Highway Department is now experimenting with the device, attempting to accurately measure new highway pavement thicknesses. The instrument works like this:

Aluminum foil strips are placed on the base course of a roadway at regular intervals; concrete pavement is then poured over the roadway. A specially calibrated gauge, called by its developers the Mark IV Eddy Current Proximity Gauge, is placed atop the wet concrete and over the embedded metal target strips. The gauge detects each strip and measures its distance from the top surface, thereby measuring the pavement's thickness.

The instrument under study by the Pennsylvania Highway Department consists of a portable, three-unit system: The gauge, mounted in a cylindrical casing about two feet long and weighing about four pounds; a separate battery container, attached to the gauge housing; and a calibrated reference target.

The instrument can measure thicknesses up to 12 inches, and to an accuracy of plus or minus one-quarter inch. The device in Pennsylvania is an experimental model, not a production model.

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Whether it becomes a production model depends on how satisfactory the highway department finds the prototype.

The Mark IV gauge already has distinct advantages over the other two devices studied by the Pennsylvania people: An ultrasonic unit that weighs 400 pounds and costs several thousand dollars, and buried radioisotopes that cost about $10 each.

Mark IV gauge can also be used as close as six or eight feet behind concrete-pouring equipment, thereby speeding highway inspection and allowing corrections in thicknesses to be made within minutes after concrete is poured.

The metal detecting gauge may have other possible applications in fields unrelated to space research. Metal fragments such as shrapnel or other foreign metallic objects could be detected inside the human body. This would help doctors in their search for the exact location of such fragments. It would be a quicker and often less difficult method than x-rays, and could be used where x-rays are unavailable or impossible to use.

Still another potential application, made timely because of recent international concern over airline piracy, is using portable gauges as metal detectors for passengers before they board aircraft. The instrument could be calibrated to detect relatively large metal objects (e.g., firearms or grenades), but would not be triggered by small metal items

such as watches, rings, keys or cigarette lighters.

Application of space age technology to the economy is the function of the Technology Utilization Office. The office finds innovations and discoveries and makes them known to public and private enterprises and assists with their adaptation to beneficial, non-space uses.

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October 14, 1970

IMMEDIATE RELEASE

Release No. 70-213

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MARSHALL SPACE FLIGHT CENTER, Ala. -- A model of a solar experiment scheduled to fly on the National Aeronautics and Space Administration's Apollo Telescope Mount in 1972 worked well in space on a recent Aerobee rocket flight at White Sands, N. M.

The solar experiment, designed by the Naval Research Laboratory, successfully photographed the sun for 300 seconds during the flight.

Dr. Richard Tousey, principal investigator, Naval Research Laboratory, said the test flight provided engineering data which verified the system design. He said the instruments recorded "excellent scientific data which has been enthusiastically received by the scientific community."

The model ATM experiment was launched on Aug. 13 at White Sands. It was carried 115.3 miles into space by an Aerobee launch vehicle. The Aerobee is a small sounding rocket used primarily for weather research.

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The NRL experiment (S-082) has two instruments. One is an extreme ultraviolet spectroheliograph designed to photograph images of the total sun disk in the various wavelengths between 150 and 650 angstroms. The second instrument is an extreme ultraviolet spectrograph designed to photographically record line spectrograms of the solar radiation between 970 and 3,940 angstroms from selected small areas on the solar disk and at different levels across the limb of the sun and into the corona.

Experiment results were recorded on film and the experiment package was recovered immediately after the flight.

Dr. Tousey and his staff are evaluating the data gathered during the flight. He said this is the third time the experiment has been flown. The experiment package experienced stability and pointing problems during the earlier two flights.

William Keathley, of the Marshall Center's ATM Program Office, was present at the launch.

The Apollo Telescope Mount will be one of the main elements of the Skylab cluster scheduled for launch in 1972. The ATM will carry eight instruments used in five major experiments provided by principal investigators.

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October 26, 1970

IMMEDIATE RELEASE

Release No. 70-218

MARSHALL SPACE FLIGHT CENTER, Ala. -- Two sight-switch controlled motorized wheelchairs provided by the NASA-Marshall Space Flight Center here will be evaluated soon by medical personnel in Texas and California institutions.

One of the wheelchairs will be delivered to the Texas Institute of Rehabilitation and Research at the Texas Medical Center in Houston, Texas, Wednesday (Oct. 28) for evaluation.

A second wheelchair is scheduled to be delivered in November to Roncho Los Amigos Hospital in Downey, Calif.

John Graham, MSFC Technology Utilization Office, will deliver the chair to the Texas institution and demonstrate it.

Graham said the switch used to control a motorized wheelchair allows afflicted persons or accident victims a great deal of movement without assistance.

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The sight switch is a head-worn device which provides a method of opening and closing an electrical circuit by eye movement. Eye movements allow the one confined to the wheelchair to start, stop and turn the chair without using his limbs.

The switch is a space age development. Graham said the device was perfected by space engineers to give astronauts undergoing extreme flight conditions a way of operating essential switches.

Hayes International Corp., Huntsville, built the two units. The firm has been extending the application of the sight switch as a control device for the handicapped.

Control applications being studied include telephone dialing; bed positioning; television set operation; page turner; typewriter operation; self feeding devices; and light, fan, door and window positioning.

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October 29, 1970

IMMEDIATE RELEASE

Release No. 70-225

MARSHALL SPACE FLIGHT CENTER, Ala. -- The National Aeronautics and Space Administration has issued a request for quotations on a study entitled, "Shuttle Orbital Applications and Requirements."

The "shuttle" is to be a space transportation system designed for reuse up to 100 times in Earth orbital missions.

As envisioned now, the vehicle would consist of a large booster stage that would carry the orbiter to an altitude of about 200,000 feet before separating and flying back to Earth. The smaller stage, carrying the payload, would proceed to orbit, complete the mission and return to Earth.

Under direction of the NASA-Marshall Space Flight Center, the contractor selected will analyze the use of the space shuttle, and flight systems delivered by it to Earth orbit, for accomplishing and supporting various prospective missions.

The contractor will do the preliminary definition of a selected

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small manned support module and any other new hardware necessary to supplement the orbiter's mission support capability.

A manned support module -- like a small "house trailer in space" -- would be carried to Earth orbit by a shuttle vehicle to serve as temporary living quarters for a crew of four.

It would be small enough to fit into the shuttle cargo bay, probably about 20 feet long and less than 15 feet in diameter. It would have no propulsion system. The support module could be joined with experiment modules, satellites, planetary probes and other objects.

Also, the contractor will define the operational and design interfaces between the ground support systems, shuttle, manned support module, special purpose flight hardware and prospective payloads or classes of payloads.

Another objective of the study is to provide total mission descriptions, including definition of the new flight hardware required, systems interfaces, support requirements, new hardware costs and schedules, and pertinent integration and prelaunch schedules for selected shuttle-payload combinations.

Due date for the quotations is November 23, 1970.

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October 29, 1970

IMMEDIATE RELEASE

Release No. 70-226

MARSHALL SPACE FLIGHT CENTER, Ala. -- An electronic device designed to instantly measure heart rates of astronauts may prove to be useful in monitoring heart rates of cardiac patients as well.

The device, a heart rate tachometer, was recently invented by two electronics experts at the NASA-Marshall Space Flight Center.

A patent application for the heart rate tachometer has been filed by inventors James R. Currie and Ralph R. Kissel, both of the Marshall Center's Astrionics Laboratory.

Currie and Kissel developed the device as a means of monitoring astronauts' heart rates while they live in orbiting space stations for long durations. However, another approach to that problem has been taken by the space agency.

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Currie explains the unique feature of the invention is that an almost instantaneous rate is available -- after only two heart beats are measured. Other techniques only average the pulse over a period of time to obtain a rate.

Electrocardiogram information is taken from the person being monitored by any number of ways, the inventors say. These include having the person grasp two electrodes or by placing leads on the body. The device, which is controlled by electric impulses from the body, generates a heart rate output by measuring the period separating two heart beats.

The inventors say their system can measure heart rates between 40 and 200 beats per minute to an accuracy of less than one heart beat.

Heart rate information developed by the tachometer is best displayed on a time-base graph. Other display methods include a meter, or strip chart recorder. The inventors point out that other readout devices may be used for particular applications.

Currie developed the electronics for the system and Kissel worked out a unique computer program to optimize circuit design.

A working model of the heart rate tachometer has been built and tested in the laboratory by the inventors.

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October 30, 1970

IMMEDIATE RELEASE

Release No. 70-227

MARSHALL SPACE FLIGHT CENTER, Ala. -- Dr. George N. Constan, former manager of the Michoud Assembly Facility, New Orleans, La., recently returned to a position at the NASA-Marshall Space Flight Center.

Dr. Constan is a special assistant to the director of Program Management.

Dr. Eberhard Rees, MSFC director, made the announcement that Dr. Constan has rejoined the Marshall Center.

Dr. Constan is responsible in his job for developing and maintaining effective contact between the Marshall Center's off-site facilities at Michoud Assembly Facility, Mississippi Test Facility, Bay St. Louis, Miss., and the Michoud Computer Operation Office, Slidell, La.

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He will also coordinate major policy decisions affecting the Marshall Center and the off-site facilities.

Dr. Constan's office is located at the Slidell computer complex.

In making the announcement, Dr. Rees said, "This function becomes increasingly important due to the multi-faceted activities both on-going and planned for these sites, and the need to ensure maximum and efficient use of government facilities."

A native of Sparta, Greece, Dr. Constan was graduated from Clemson College in South Carolina in 1933 and started a government career in 1942 when he entered military service. He was an Army ordnance officer for four years and in 1948 became chief of the Ammunition Division at Milan Arsenal, Milan, Tenn.

Later he served at Joliet Arsenal, Ill., and at Redstone Arsenal.

After joining NASA, Dr. Constan continued to serve at Redstone Arsenal until 1961 when he was named director of the Michoud Assembly Facility. He left MSFC as director of the Michoud installation in August 1969 to join private industry.

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October 30, 1970

IMMEDIATE RELEASE

Release No. 70-228

MARSHALL SPACE FLIGHT CENTER, Ala. -- Dr. Ernst Stuhlinger, associate director for science at the NASA-Marshall Space Flight Center, recently received the Roentgen Prize in Germany for his work in the space sciences.

The award was presented to Dr. Stuhlinger at the annual meeting of the Konrad Roentgen Society in Remscheid, West Germany. He was keynote speaker at the meeting.

In Germany to attend the 21st International Astronomical Congress at Konstanz, Dr. Stuhlinger also spoke to scientific groups in Berlin, Essen, Munich, Stuttgart, and Remscheid.

Dr. Stuhlinger received the Roentgen Prize for his contributions to the development of satellites and "their use for scientific exploration of space, particularly the various kinds of radiation emanating from celestial bodies."

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The prize also pays tribute to "the NASA team which...was instrumental in creating this new tool of scientific research..."

The prize is named in honor of Wilhelm Konrad Roentgen, who discovered the x-rays and received the first Nobel Prize in physics. The award is given by the Science Department of Justus Liebig University, Giessen, West Germany.

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November 5, 1970

IMMEDIATE RELEASE

Release No. 70-229

MARSHALL SPACE FLIGHT CENTER, Ala. -- An awards ceremony to observe the successful completion of more than four years of Saturn V launch vehicle test firings will be held at the NASA-Mississippi Test Facility (MTF) Monday morning, Nov. 9.

Among guests invited to the ceremony are Mississippi Governor John B. Williams and U. S. Senator John Stennis. They are expected to head a list of federal, state and local government officials who will pay tribute to the work of several thousand workers at the NASA test site during the Saturn V test program. MTF workers represent NASA, private contractors and several government agencies.

Mayors and other government officials from MTF surrounding communities and counties in southern Mississippi and southeast Louisiana have also been invited to the ceremony.

NASA leaders at the awards program are expected to include Dr. George M. Low, acting administrator; Dale D. Myers, associate

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administrator, Office of Manned Space Flight; Dr. Eberhard Rees, director of the Marshall Space Flight Center, Huntsville, Ala., parent organization of MTF; Lee B. James, Marshall Center director of Program Management, responsible for the Saturn V program; and Jackson M. Balch, manager of the Mississippi Test Facility.

Astronaut Fred W. Haise, Jr., lunar module pilot in the Apollo 13 crew, will be at the ceremony to present a U. S. flag to all MTF employees. The flag, representing the thanks of NASA's Apollo astronauts, flew around the moon during the Apollo 10 mission in May 1969.

Special plaques will be given to representatives of NASA's prime contractors at MTF for their contributions to the successful completion of the Saturn static firing program. Receiving the plaques will be Ed. T. Foster, MTF base manager for the Boeing Co.; Gerald L. Wilson, director of MTF Space Division operations for North American Rockwell Corp.; Ernest W. Brumitt, field manager for North American's Rocketdyne Division; and Arthur G. Woodside, MTF manager for General Electric Co.

The Boeing Co. conducted the test firings of 13 first (S-IC) stages of the Saturn V; North American Rockwell Corp., through two company divisions, tested 15 second (S-II) stages of the Saturn moon rocket; and General Electric Co. has managed operational and technical services at MTF since the site was established in 1963.

Other contractors and groups of government workers will receive special plaques and awards at the ceremony. An honor roll of companies and organizations that have contributed to MTF's test program is on permanent display in the site's main building.

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November 9, 1970

IMMEDIATE RELEASE

Release No. 70-233

MARSHALL SPACE FLIGHT CENTER, Ala. -- Two national technical societies -- the American Institute of Aeronautics and Astronautics and the American Astronomical Society -- will hold related conferences on solar physics in Huntsville next week. MSFC officials are prominently involved in both meetings and both groups will tour the Marshall Center.

This is the first time the two societies have held joint meetings on this subject. Several hundred solar physicists and scientists and engineers working on applied solar problems will attend. About 80 scientific papers will be presented.

The AIAA will meet Nov. 16-18 at the Carriage Inn and the AAS will meet Nov. 17-19 at the Sheraton Inn. Persons registered for either conference may attend sessions of both, and a joint program has been planned for the morning of Nov. 18 at the Carriage Inn. That session will be chaired by Dr. Ernst Stuhlinger, MSFC assistant director for science.

Dr. Leonard L. DeVries of Marshall's Aero-Astrodynamics Lab is general chairman of the AIAA conference with Gerhard B. Heller, director of the Space Sciences Lab, as program chairman. The AAS meeting will be headed by Dr. John W. Firor, Jr., director of the National Center for Atmospheric Research, Boulder, Colo.

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November 17, 1970

IMMEDIATE RELEASE

Release No. 70-235

MARSHALL SPACE FLIGHT CENTER, Ala. -- Two Skylab Program reviews are underway today at the NASA-Marshall Space Flight Center.

An extravehicular activity critical design review is being held at the Skylab mockup area and the Neutral Buoyancy Simulator.

Charles W. Mathews, deputy associate administrator, Office of Manned Space Flight, NASA Headquarters, is chairman of a Skylab Subsystems Review Team meeting here today.

The EVA review, which started Monday, includes astronaut performances under normal Earth gravity in the Saturn Workshop mockup and simulated weightlessness in the Neutral Buoyancy Simulator.

Ten astronauts from the Manned Spacecraft Center, headed by Russell Schweickart, took part in the review activities on Monday. The week-long review ends Friday.

The Skylab Subsystems Review Team meeting opened today with an inspection of the Skylab mockup area. Chairman Mathews and the

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team members also toured simulation facilities in Astrionics and Manufacturing Engineering laboratories and viewed Apollo Telescope Mount hardware being assembled in the Manufacturing Engineering Laboratory. The review team ends its activities here on Thursday.

MSFC is responsible for developing most of the elements of the Skylab cluster of spacecraft. Skylab is to be launched in late 1972. It will accommodate three men in earth orbit for successive stays of up to two months.

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November 17, 1970

IMMEDIATE RELEASE

Release No. 70-237

MARSHALL SPACE FLIGHT CENTER, Ala. -- The flight model of a Skylab multiple docking adapter will be flown Wednesday (Nov. 18) from the NASA-Marshall Space Flight Center here to the Martin Marietta Corporation Space Center in Denver, Colo.

The multiple docking adapter (MDA) is being flown to Denver aboard the Super Guppy aircraft.

The flight MDA structure was manufactured at the Marshall Center's Manufacturing Engineering Laboratory.

At Martin-Denver, the MDA will be outfitted with controls and display panels for solar astronomy and Earth resources experiments, storage vaults for experiment film and the thrust attitude control system.

When completely equipped the MDA will be taken to McDonnell Douglas Astronautics Co. facilities in St. Louis, Mo., for mating with the flight version of the Skylab airlock. After this mating, the

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unit will be put through a simulated mission in an altitude chamber. Astronauts will participate in this simulated space test.

The MDA structure is slightly more than 17 feet long and is 10 feet in diameter. It contains docking ports for docking the Apollo spacecraft and viewing ports for earth resources experiments.

Martin Marietta is integrating contractor for payload and experiments on Skylab as well as being responsible for outfitting the MDA and designing and building several experiments.

This MDA is one of the major elements of the Skylab cluster scheduled for launch in 1972 by a Saturn V launch vehicle. The The NASA-Marshall Space Flight Center directs Skylab development.

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November 19, 1970

IMMEDIATE RELEASE

Release No. 70-239

MARSHALL SPACE FLIGHT CENTER, Ala. -- McDonnell Douglas Astronautics Co., Eastern Division, has been asked to design a structural test program for the proposed space shuttle it is studying for the NASA-Marshall Space Flight Center.

The company is one of two aerospace firms making detailed studies of national space shuttle transportation systems. The new work, valued at $2 million, is a modification to the basic contract between McDonnell Douglas and NASA.

McDonnell Douglas will submit its recommendations for a program to test all structural components of the proposed space shuttle's booster and orbiter craft, including verification of design and advanced state-of-the-art testing of materials, wing leading edges and propellant tanks.

The design of the test program will be done concurrently with the remainder of the space shuttle study, and is scheduled to be completed by Dec. 15, 1971. The work will be done at McDonnell Douglas plants

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in St. Louis and Huntington Beach, Calif., and at a subcontractor plant in Denver.

The Manned Spacecraft Center, which has a companion space shuttle study under way, is negotiating a similar amendment with its contractor, North American Rockwell Corp.

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December 2, 1970

IMMEDIATE RELEASE

Release No. 70-246

MARSHALL SPACE FLIGHT CENTER, Ala. -- A Saturn Workshop will be shipped from the McDonnell Douglas Astronautics Co. facility at Huntington Beach, Calif., Dec. 4 to the NASA-Manned Spacecraft Center in Houston, Texas, for extensive ground tests.

This workshop is a ground test version of one which will be used in the Skylab program to accommodate teams of three astronauts for stays up to 56 days in earth orbit. The space agency plans to launch the Skylab cluster with a Saturn V vehicle in 1972.

Called a "dynamic test article," the workshop model will undergo a series of tests at MSC to verify its bending and vibration characteristics.

McDonnell Douglas technicians loaded the workshop aboard the Point Barrow for shipment to the Michoud Assembly Facility in New Orleans, La. The Point Barrow is scheduled to arrive in New Orleans on Dec. 17.

The workshop will be loaded aboard a NASA barge at Michoud for shipment on Dec. 30 to Houston. It is scheduled to arrive at the Houston port on Jan. 5.

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The workshop model is a Saturn S-IVB stage converted by McDonnell Douglas, manufacturer of the flight workshop, for its ground test role. The structure was formerly the third (S-IVB) stage on the Saturn V facility vehicle used to checkout assembly and ground test equipment at the NASA-Kennedy Space Center.

McDonnell Douglas has changed the stage to a workshop configuration by installing crew quarters floors and other partitions. Actual or simulated equipment has been used to give the model the same mass and dynamic characteristics as a flight version.

At MSC, the highly instrumented vehicle will first be placed in an acoustic chamber and subjected to sound waves which simulate the Saturn V launch acoustic environment. After a series of tests at different sound intensities, it will be moved to another chamber and connected to electromagnetic "shakers" which will simulate elements of the launch environment such as vibration.

The test program at MSC is to last from about the end of January to the middle of May, 1971.

Following those tests, the vehicle will be moved to the Marshall Space Flight Center where static load testing will be done in MSFC's Astronautics Laboratory. Loads placed on the vehicle will simulate the forces which the main structural elements of the workshop will encounter prior to launch and during launch and orbital flight.

The Marshall Center directs the workshop development program.

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December 1, 1970

IMMEDIATE RELEASE

Release No. 70-248

MARSHALL SPACE FLIGHT CENTER, Ala. -- Principal investigators of candidate experiments for the High Energy Astronomy Observatory (HEAO) are meeting with National Aeronautics and Space Administration officials and study contractors today and tomorrow, Dec. 1-2, at the NASA-Marshall Space Flight Center.

Approximately 36 people are attending the series of meetings, including the scientific investigators and representatives of the Grumman Aerospace Corp. and TRW Systems Group, study contractors. NASA representatives are from Washington, the Goddard Space Flight Center, Greenbelt, Md., and the Marshall Center.

An HEAO steering group, composed of about 10 members from the larger group, will hold a meeting Wednesday afternoon. The steering group is chaired by Dr. Frank McDonald, NASA scientist from the Goddard Space Flight Center.

HEAO is being studied as a possible scientific carrier for astronomy experiments that would study certain facets of the universe from Earth orbit. Its probable launch date will be in 1974.

The current meetings are part of the preliminary design and definition study phase of the program. Marshall Center manager of the HEAO Task Team is R. D. Stewart.

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December 3, 1970

IMMEDIATE RELEASE

Release No. 70-250

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has invited industry to submit proposals on the preliminary design of a Research and Applications Module (RAM) which could be used with the space station and space shuttle currently being studied.

Proposals for the 12-month design studies are due Jan. 8, 1971.

Three conceptual (Phase A) studies of the RAM were recently completed for NASA. This initial work was done by McDonnell Douglas/Martin Marietta; North American Rockwell/General Electric; and General Dynamics/Convair.

The firm selected for this new contract will carry the work through preliminary design.

The space agency is currently studying the use of a space shuttle for low cost transportation to orbit and the space station as a semi-permanent facility which would have general and special purpose laboratories.

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The RAM concept offers an economical way to extend the capability of both the shuttle and space station. These modules will provide versatile and economical laboratory facilities for doing Earth orbital research and applications work.

RAMs, while using many common features, can be specifically adapted for investigations in many fields, including astronomy, space physics, bioscience, biomedicine, Earth surveys, materials sciences and processing, communications and navigation and advanced technology.

Scientific specialists onboard a shuttle or space station could be used for observation; interpretation; adjustment, service or repair of equipment; and changing the procedures and apparatus.

The flexible RAM concepts will encourage a broad user community, involving government agencies, university and industry and commercial interests. Foreign participation is being encouraged in all phases of the RAM program. These concepts will allow users, such as a foreign country or group of countries, to conceive, outfit, and man their own specialized laboratory. Officials of European space organizations have expressed interest in the concept and are following the U. S. activity very closely.

For the purposes of this preliminary design study, the first module launch would be planned for 1978 and be a part of a modular space station which would have an orbital lifetime of 10 years or

more or alternatively operate in a shuttle sortie mode. The maximum size of a module would depend upon the shuttle's cargo capacity. This could be 14 feet in diameter and up to 58 feet long, with a weight of 20,000 pounds.

Two modes of operating RAM units are being considered by the space agency. Plans are to operate RAMs either attached to the shuttle or space station or as free-flying units. Free-flying modules could be returned to the Earth by the shuttle or to the space station for servicing and maintenance. Such free-flying modules may be required for experiments which are extremely sensitive to vibrations, contamination or unique pointing accuracy.

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December 3, 1970

IMMEDIATE RELEASE

Release No. 70-251

MARSHALL SPACE FLIGHT CENTER, Ala. -- The NASA-Marshall Space Flight Center has modified an existing contract with the Boeing Co. for work on Saturn V launch vehicle's first stages.

The contract modification totals $21,029,756.

This change extends the contract performance period through March 31, 1973. Space agency officials said the extension was caused by a redirection of the Apollo program calling for longer periods between missions.

The Boeing Co. builds the Saturn V first (S-IC) stages at the Michoud Assembly Facility in New Orleans, La. Work under this contract modification will be performed at the Michoud plant.

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December 3, 1970

IMMEDIATE RELEASE

Release No. 70-252

MARSHALL SPACE FLIGHT CENTER, Ala. -- The space agency's candidate manned Earth orbital experiment program for the next decade is being discussed Wednesday and Thursday (Dec. 2-3) at the NASA-Marshall Space Flight Center.

More than 150 scientists and engineers representing government and industry are attending the meeting. Purpose of the conference is to discuss changes to a planning document detailing proposed manned space flight experiments.

General Dynamics' Convair Division has a contract for updating the document entitled "Reference Earth Orbital Research and Applications Investigations" or more frequently called the "Blue Book." General Dynamics personnel are presenting the results of their studies.

NASA uses the Blue Book as the primary source of experiment program data which will be used in the continuing space station

-more-

studies, space shuttle studies, research and applications module studies and other manned space flight planning activities.

Experiment fields covered in the planning document include astronomy, life sciences, space physics, Earth observations, communications/navigation, technology and materials science and manufacturing.

Scientists and engineers from NASA Headquarters in Washington, D. C., Manned Spacecraft Center, and other NASA centers are participating in the discussions. Three French representatives of the European Space Research Organization are also attending.

The Marshall Center directs the work being done by General Dynamics on updating the Blue Book. W. T. Carey, Program Development, heads the MSFC work. Other Marshall Center engineers and scientists are serving as members of teams reviewing major experiment fields.

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December 14, 1970

IMMEDIATE RELEASE

Release No. 70-256

MARSHALL SPACE FLIGHT CENTER, Ala. -- In the high desert near Flagstaff, Ariz., a blindfolded jeep gropes its way across rock-strewn, scrubby countryside. Its windows are masked, its interior is dark, no driver is visible to guide its cautious forward movement.

Perched atop the jeep's front roof edge, however, is the long snout of a television camera, moving slowly from side to side as if sniffing out the shape of the ground directly before it.

Trailing the jeep by a hundred feet or so is a second uncommon vehicle, an outsized station wagon. Its driver can see clearly, but all windows behind his cabin are shuttered.

This small, strange caravan is not from another world, but it is helping test the operation of an other-worldly machine, NASA's lunar roving vehicle. With these and other vehicles, engineers from the Marshall Space Flight Center are learning how accurately they can remotely operate a moon vehicle with the simplest and least amount of navigation equipment.

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The journey to Flagstaff's look-alike moonscape began in September 1969 when engineers in the Marshall Center's Astrionics Laboratory were asked to study the lunar roving vehicle's navigation system.

The first system envisioned for the LRV was a wonder of sophistication -- it was also complicated, fragile and expensive. The Astrionics Lab engineers were asked to recommend changes or improvements.

They did better than that; they developed a simple, rugged and cheap system based on the principle of dead reckoning navigation. Then they tested their system to prove that it would work. That's what the Flagstaff desert run is all about.

Dead reckoning navigation is a relatively simple idea, used by sailors and fliers for many years, but it had never been seriously considered for simple land navigation until the Marshall Center people decided to try it for planetary travel. The principle requires starting from a known point, continuously determining direction and distance traveled, and periodically calculating positions from this data.

The Marshall Center-developed system uses a directional gyroscope to give a constant reference direction, an odometer that determines distance traveled with pulses that originate from magnets mounted on the wheels, and a signal processor unit that uses direction and distance to compute measured distances traveled north and east. The addition of a sun shadow compass insures correctness of the

initial heading, and can periodically check for slight drift of the gyro.

On the moon the known starting point will be the lunar module's landing site. The roving vehicle's direction, distance and other information will be fed into the processor. Lunar landmarks (e.g., mapped craters, hills, rills and other features) will also verify correct navigation.

The Marshall Center's development and testing is being done by engineers in the Astrionics Lab's Guidance and Controls Division. Peter Broussard, chief of the Sensors Branch, heads the project. Working with him are John L. Burch, William C. Mastin and Bobby F. Walls. They get help from many others at the Marshall Center and from the U.S. Geodetic Service at Flagstaff.

The very first tests of the proposed navigation system were held in the fields surrounding the Marshall Center. The main sources of error were slight gyro drift, misalignment and wheel slippage (causing odometer calibration errors). These were relatively minor errors, and the sun compass was added to the navigation equipment to correct most errors.

Two series of navigation system tests have been run near Flagstaff. The first series, held last March and April, used a commercial all-terrain vehicle to test the MSFC system. The six-wheel, two-cycle-engine vehicle is similar in size to the proposed manned lunar roving vehicle. Its good slope climbing ability made it ideal for maneuvering on the rugged desert plateau.

The Marshall Center system, assembled from components that were cheaply and quickly available, was successful in the spring tests. The directional gyro proved its accuracy; in several sorties, including some of up to 20 miles, the all-terrain vehicle returned to within less than 100 yards of its starting point.

That is admittedly less than pinpoint precision, but since the lunar module will be the starting point on the moon, astronauts won't have trouble spotting the LM once they get within a hundred yards of it.

The second series of Flagstaff tests, held last summer, used the two-vehicle caravan to learn how a lunar vehicle could be operated remotely from Earth.

The jeep represents an LRV left on the moon by astronauts. The driver is enclosed so he will drive as much as possible by following directions from an Earth control station, which is simulated by two men sealed in the back of the station wagon. Inside his cocoon, the jeep driver is surrounded by a small map table, TV controls, readouts from the navigation system (mounted on the jeep's rear), and facing the steering wheel and a TV monitor mounted on the dashboard. He is a very busy man.

The controllers in the back of the station wagon work at a special table and have a TV monitor, dead reckoning system readouts, and other control aids. Voice communication between the two vehicles is by walkie-talkie to compare observations and coordinate information.

The TV camera is perched atop a stand on the jeep's hood, generally at roof level. It scans the ground before and around the vehicle and transmits what it views to the two monitors. The controllers relay maneuvering commands to the jeep driver. The camera didn't have to be moved very often during the tests, and its field of view was adequate for picking out landmarks. The observers had no special difficulty getting accustomed to looking at terrain through the distortion of monoptic, black-and-white TV. The camera's zoom lens proved valuable in identifying landmarks and examining far-off objects.

Many sorties were made during the tests, ranging up to more than 15 miles. Photographs and topographic maps (comparable in quality to Lunar Orbiter spacecraft photos) were used to follow the ground courses. Geological targets such as depressions, hills and rock formations were sought and used as landmarks during traverses. The TV camera also helped update the navigation system.

The Flagstaff desert runs proved that by using a directional gyroscope, odometer calibration, and sun compass alignment and updating, traverses of almost 19 miles (30 kilometers) can be made with less than two percent overall error. Remote control navigation from Earth can be successfully done with the use of a monoptic TV camera plus Lunar Orbiter-quality maps and photographs.

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A third series of tests at Flagstaff recently evaluated flight hardware components for the lunar roving vehicle. During these latest test runs, the Astrionics Lab engineers also added more data to support the already proven reliability of their navigation system.

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December 15, 1970

IMMEDIATE RELEASE

Release No. 70-257

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MARSHALL SPACE FLIGHT CENTER, Ala. -- A lunar roving vehicle (LRV) test vehicle, called a qualification test unit, is scheduled for completion by the Boeing Co. this week at its Kent, Wash., manufacturing plant. Boeing is producing the vehicle for the National Aeronautics and Space Administration under the direction of the Marshall Space Flight Center.

Built like a production model of flight LRVs, the test unit is of the same configuration as a flight vehicle, although it will never fly. It will be used on Earth to test various LRV systems and equipment.

Immediate tests of the qualification vehicle will begin at Boeing's Kent plant and move to the Manned Spacecraft Center, Houston, for additional tests in February.

The planned test series at Kent will begin with post-manufacturing checkout and electro-magnetic interference tests. These will be followed by space support equipment integration and vibration tests, ground support equipment integration tests, unit vibration, and thermal vacuum tests.

The Houston tests will concern electro-magnetic compatibility of the LRV with other Apollo communications and scientific hardware.

During the missions of Apollo 15 through 17, which will include LRV activities, the qualification vehicle will be used as a trouble-shooting tool on any flight problems that may arise while a flight model is operating on the moon.

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December 15, 1970

IMMEDIATE RELEASE

Release No. 70-260

MARSHALL SPACE FLIGHT CENTER, Ala. -- The three companies conducting nuclear shuttle studies for the NASA-Marshall Space Flight Center will give progress reports to MSFC authorities in a series of meetings tomorrow and Thursday (Dec. 16-17) here.

The firms carrying out this work are Lockheed Missiles and Space Co., North American Rockwell Corp. and McDonnell Douglas Astronautics Co.

Ronald Harris of Program Development said the three briefings "will concentrate primarily on the work accomplished in the areas of operations requirements and systems definition."

In addition, several companies conducting technology studies related to the reusable nuclear stage will present summary reports Thursday afternoon. They include General Dynamics/Fort Worth, Whittaker Corp., Hughes Aircraft Co., Aerojet Nuclear Systems Co. and North American Rockwell. These technology studies are being done under the direction of the MSFC Astronautics Lab.

The nuclear vehicle being studied is proposed for use in space, to provide propulsion between low and high earth orbits, between the Earth and the moon, and into deep space.

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December 16, 1970

IMMEDIATE RELEASE

Release No. 70-262

MARSHALL SPACE FLIGHT CENTER, Ala. -- A meeting to review two parallel studies of a proposed chemical inter-orbital space shuttle was held at the NASA-Marshall Space Flight Center yesterday.

Two aerospace firms, North American Rockwell Corp. and McDonnell Douglas Astronautics Co., are making detailed analyses of what modifications would be required to adapt either the second (S-II) stage or the third (S-IVB) stage of the Saturn V launch vehicle into an inter-orbital shuttle for operation to and from Earth orbit and lunar orbit.

Marshall Center managers assume that further lunar exploration, if approved and funded, will require a shuttle much larger than the Apollo spacecraft in order to transport larger payloads and crews between Earth orbit and the moon.

Prime objectives of the two analyses are to make preliminary designs of how the stages must be modified, determine orbital

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launch operations and procedures, and gather information on preliminary costs, logistics and facilities.

Whichever stage is chosen would be carried into Earth orbit attached to a newly developed space shuttle booster. North American builds the S-II stage, and McDonnell Douglas builds the S-IVB stage.

About 45 people, most of them from the Marshall Center, attended the all-day meeting, called a "mid-term review" because the two seven-month studies are now half completed. Both efforts began Sept. 1 and are due to end Apr. 1, 1971.

The contractors' investigations are being reviewed before preliminary designs are prepared of the preferred concepts of each stage.

Meeting discussions included results of the analyses to date, definition of systems requirements, necessary systems and subsystems trade-offs, and selection of preliminary configurations.

Coordinator for the meeting was Sidney Saucier, Advanced Systems Analysis Office in Program Development.

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December 18, 1970

IMMEDIATE RELEASE

Release No. 70-266

MARSHALL SPACE FLIGHT CENTER, Ala. -- Two Saturn V flight stages (S-II-15 and S-IVB-512) are enroute today to the NASA-Kennedy Space Center, Fla., and a Saturn Workshop test model will soon complete its journey to the NASA-Manned Spacecraft Center, Houston.

The vehicles are being shipped by the NASA-Marshall Space Flight Center.

The ship Point Barrow reached MSFC's Michoud Assembly Facility, New Orleans, from California yesterday, carrying the Saturn Workshop and the S-IVB-512. The workshop was unloaded for later shipment to MSC, while the S-II-15, which had been brought from the MSFC Mississippi Test Facility the previous day, was loaded aboard the Point Barrow for the remainder of the trip to KSC.

The ship will reach KSC Dec. 20 where the two stages will be stored until needed for flight missions.

The workshop vehicle destined for MSC, known as the "dynamic test article," will leave Michoud Dec. 31 aboard the MSFC barge Orion. It will be unloaded at a NASA dock at Clear Lake, near MSC, the first such hardware to move to the Houston center in this manner. It is to arrive Jan. 5.

The workshop model will undergo a series of tests at MSC to verify its bending and vibration characteristics.

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Another Saturn V stage, the S-II-13, will be taken from a test stand today at the Mississippi Test Facility. The stage will be prepared during the next two weeks for shipment to the Kennedy Space Center. It is scheduled to be loaded aboard the barge Posiedon Dec. 30 at MTF. The barge will leave Michoud on Dec. 31 for the trip to the Kennedy center.

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December 22, 1970

IMMEDIATE RELEASE

Release No. 70-267

MARSHALL SPACE FLIGHT CENTER, Ala. -- Highlights of 1970 at the NASA-Marshall Space Flight Center include:

* Launch of an Apollo/Saturn V vehicle.

* Renaming the space agency's embryonic space station project Skylab.

* Continuing work on the space shuttle and space station.

* Doing early planning on the unmanned astronomy satellite (HEAO).

* Dr. Eberhard Rees being named MSFC director.

These and other highlights combined to make the first year of the decade an eventful one at the space agency's largest field center.

The Saturn V (AS-508) vehicle launched the Apollo 13 mission April 11 from the NASA-Kennedy Space Center, Fla.

The Apollo 13 flight went well until an explosion rocked the ship shortly before the spacecraft reached the Moon, causing the space agency to cancel the lunar landing attempt. However, Astronauts James A. Lovell, Jr., John L. Swigert, Jr., and Fred W. Haise, Jr., safely returned to Earth using their Lunar Module as a "lifeboat."

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Astronauts Alan B. Shepard, Jr., Stuart A. Roosa and Edgar D. Mitchell are scheduled to man the Apollo 14 mission. Apollo 14 is scheduled for launch on Jan. 31, 1971. Apollo 15 is now set for July 25.

The Apollo Applications Program received its new name -- Skylab -- in March. NASA plans to launch a Skylab cluster, made up of the Saturn Workshop, Multiple Docking Adapter, Airlock Module and Apollo Telescope Mount or solar observatory, into Earth orbit in late 1972 with a two-stage Saturn V vehicle. The cluster is an embryonic space station that is being planned for use by three three-man crews for missions lasting up to 56 days.

A series of Saturn Workshop design reviews conducted at the Marshall Center and at contractor plants during the year have resulted in a firm design for the spacecraft. Workshop fabrication continues at McDonnell Douglas facilities at Huntington Beach, Calif.

Apollo Telescope Mount test and flight hardware fabrication started at the Marshall Center during the year. An ATM thermal systems unit was completed and shipped to Houston for a series of thermal vacuum tests there. Other units under fabrication here include one prime spacecraft and a backup and ground test models.

NASA selected the McDonnell Douglas Astronautics Co. and North American Rockwell Corp. in May for parallel 11-month definition and preliminary design studies of a reusable space shuttle vehicle for possible future space flight missions.

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The Marshall Center's Space Shuttle Task Team manages the McDonnell Douglas shuttle work. The two-stage space shuttle would transport crew, passengers and cargo from Earth to near space and back.

Space station studies started here in 1969 were continued by the Marshall Center during the past year. McDonnell Douglas studied for MSFC a 33-foot diameter space station which could house a 12-man crew. Such a station would operate for as long as 10 years, subject to resupply of expendables and rotation of crews with a logistics vehicle such as the shuttle. This contract is being altered to have McDonnell Douglas study a space station which would be assembled in orbit from 14-ft. diameter modules sent from Earth in the space shuttle.

A High Energy Astronomy Observatory (HEAO) project made progress during the year at the Marshall Center.

HEAO is a proposed unmanned satellite which would study very energetic radiation from space -- X-ray, gamma rays and high energy cosmic rays -- previously seen only briefly by sounding rockets and balloons, and by small satellites with poorer resolution and sensitivity.

Two companies, Grumman Aerospace Corp., and TRW Systems Group, under contract to MSFC, are conducting the preliminary design phase of the HEAO, a project of the NASA Office of Space Science and Application. In this early planning stage, HEAO is seen as a 21,000-pound, 30-foot-long spacecraft, designed to carry relatively few but

heavy instruments accounting for more than half its weight. If approved as a NASA program after the definition phase, the first HEAO is planned for launch by a Titan III rocket into a 230-statute-mile orbit in 1974.

Dr. Eberhard F. M. Rees became Marshall Center director on March 1. He succeeded Dr. Wernher von Braun, who became NASA's deputy associate administrator for planning in NASA Headquarters, Washington, D. C.

The new director served as a deputy to Dr. von Braun for more than a dozen years.

In another important organization change, Richard W. Cook was named in June to the post of deputy director, management. He replaced Harry H. Gorman, who accepted the position of deputy associate administrator for manned space flight (management) in NASA Headquarters.

A major milestone in the manned lunar roving vehicle (LRV) program was reached in November when a special training vehicle was delivered to the Marshall Center by the Boeing Co., LRV prime contractor. The vehicle, called a "1-G trainer" because it will operate in Earth's gravity, was built for Boeing by its major LRV subcontractor, the Delco Electronics Division of General Motors Corp.

The LRV is now scheduled for its first space trip on the Apollo 15 mission in July, 1971.

Saturn V rocket stage testing ended during late 1970 at the Marshall Center's Mississippi Test Facility. The final first (S-IC-15) stage

and second (S-II-15) were tested at MTF on September 30 and October 30.

NASA tests at the Mississippi test site have ended and the facility has been made available to other government agencies whose program interests are compatible with those of the space agency.

Two groups now under the new National Oceanic and Atmospheric Administration located at MTF during 1970. They are the National Data Buoy Development Project, and the National Marine Fisheries Service.

The space agency also located an Earth Resources Laboratory at the Mississippi facility. The laboratory's work is under the supervision of the Manned Spacecraft Center.

Marshall Center's personnel strength at the end of 1970 stands at 6,000, a decrease of 300 during the year.

The Civil Service payroll for 1970 totaled more than $104 million.

NASA announced an agency-wide reduction in its personnel in mid-1970. The Marshall Center's share of the reduction was scheduled to be 190 positions, however, retirements reduced this number to 121.

Marshall Center support contractors working on the Center totaled approximately 2,000 at year's end. There are an additional 1,000 support contractor employees working in Huntsville.

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